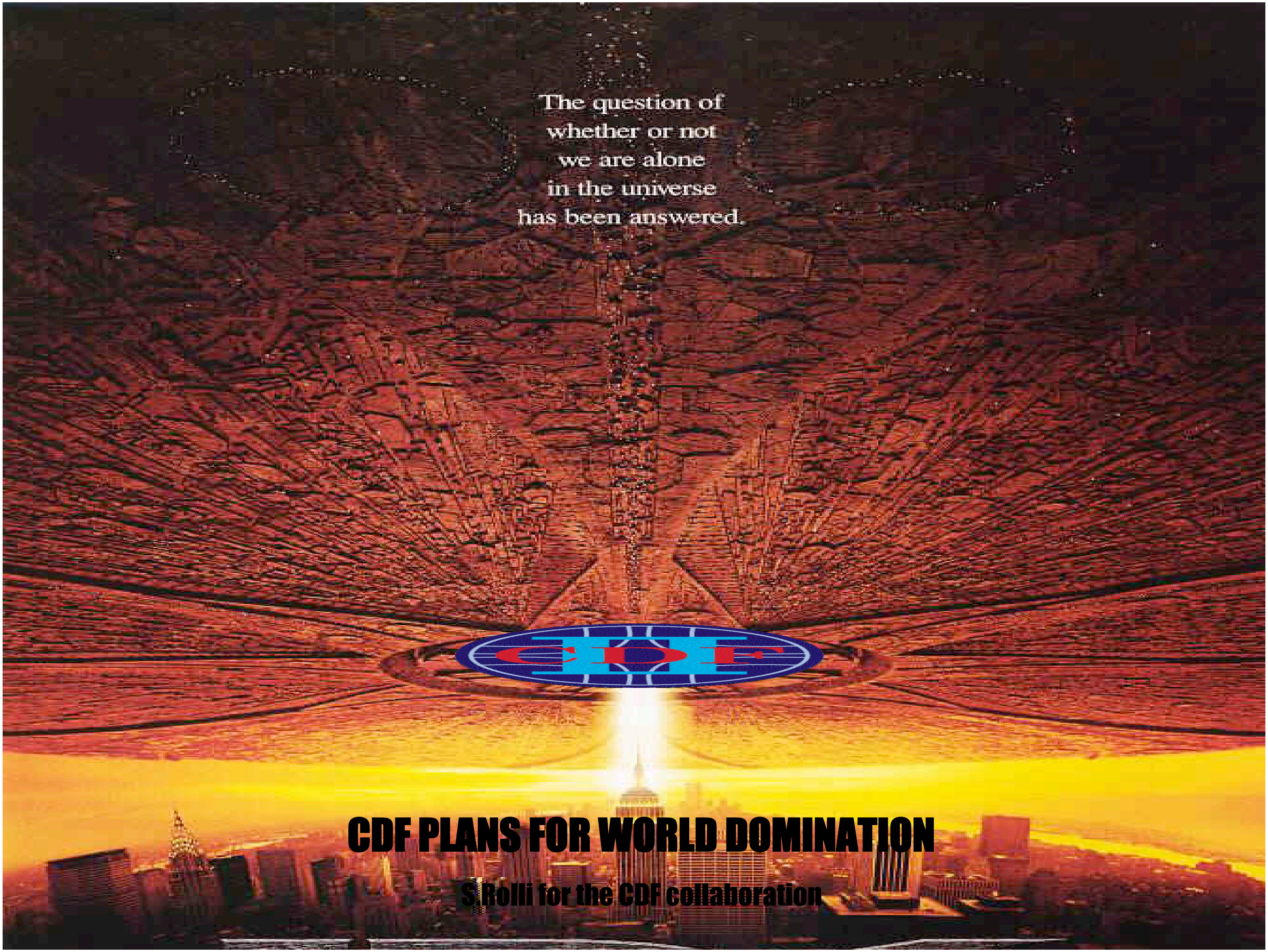

The question of
whether or not
we are alone
in the universe
has been answered.
CDF
CDF PLANS FOR WORLD DOMINATION
S.Rolli for the CDF collaboration

Recent results on top quark, electroweak and new physics searches from CDF

Simona Rolli
Tufts University
on behalf of the CDF collaboration

Introduction

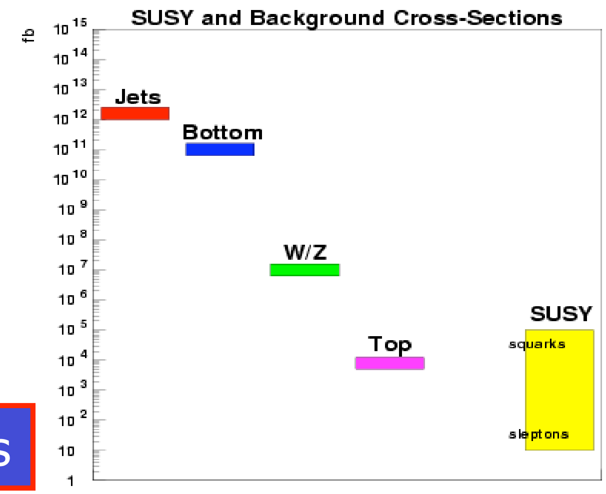
Exciting time now at CDF !

frenzy activity in physics analysis

several different physics groups
- Top quark
- W/Z physics
- Exotics

} High P_T

Cross sections for various physics processes vary over many orders of magnitude:
- processes of interest are often buried under heavy background
- need good rejection factors, selection and analysis strategies



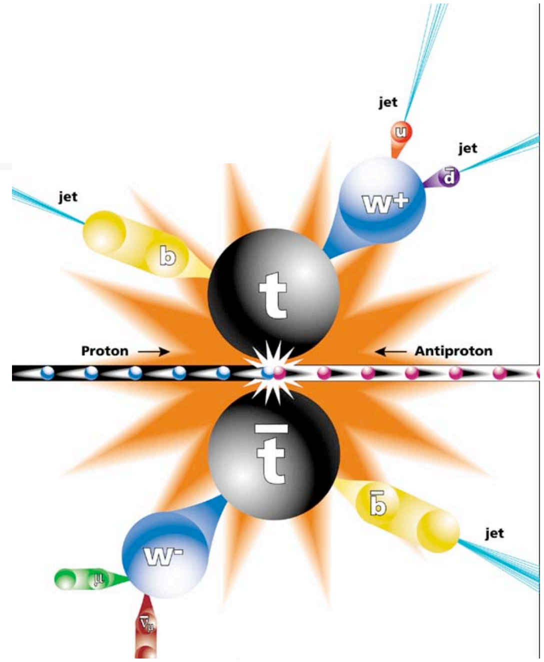
Optimize event selections for SM physics and new physics as in both cases the composition of the samples are important

Common datasets

Common identification/reconstruction cuts

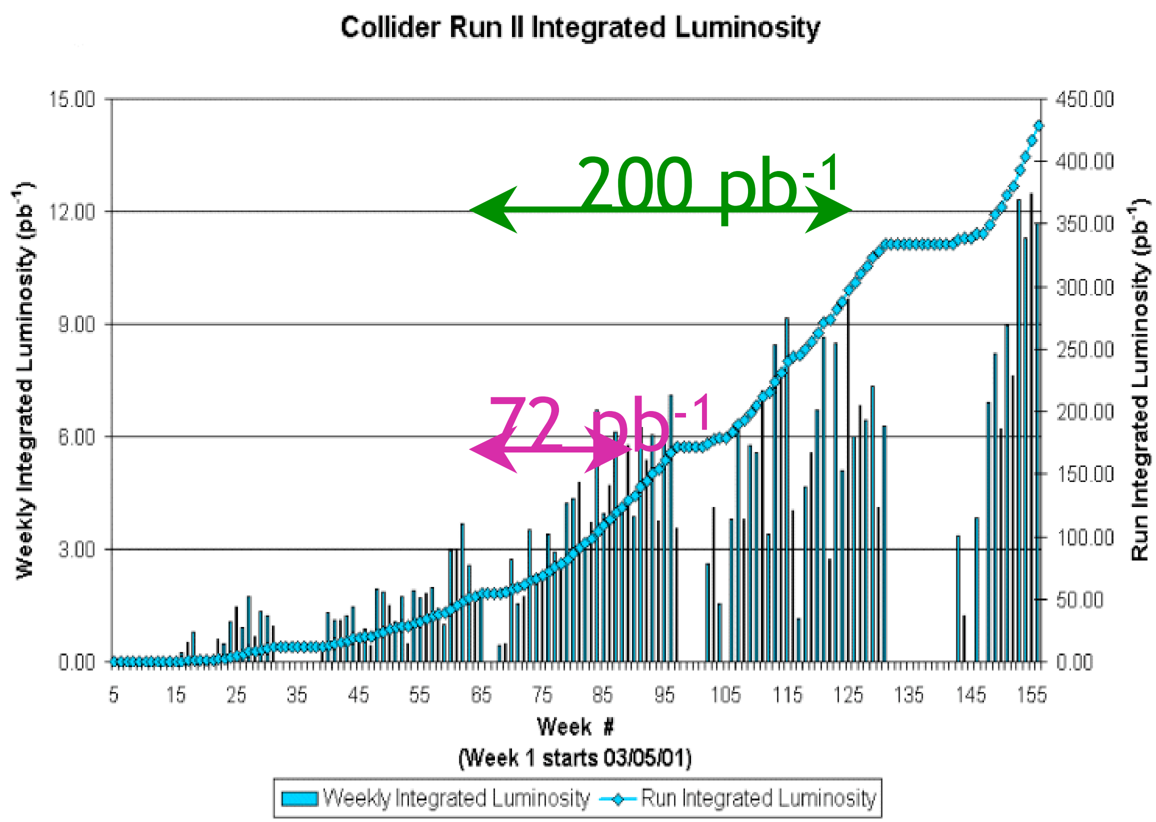
Outline of the talk

- **CDF II detector and current datasets size**
- **Physics Objects, Signatures and Results**
  - **Leptons-only final states (and isolated tracks)**
    - Z production
    - Drell-Yan studies
    - dilepton searches
  - **... + Missing Energy and Photons**
    - W production
    - Multibosons
    - excited electrons
    - GMSB in diphoton + $\not{E}_T$
  - **... + Jets and heavy flavors**
    - Leptoquarks
    - Top
    - Higgs



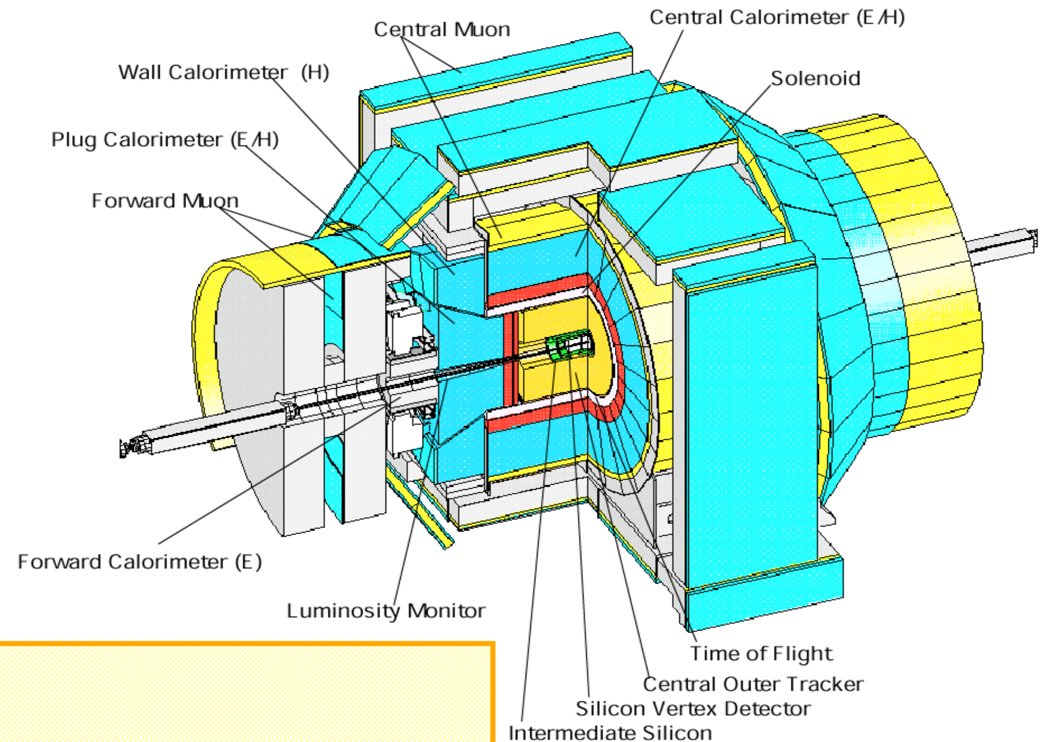
Run II Luminosity

- Tevatron has delivered ~430 pb^{-1}
- We have ~350pb^{-1} on tape.
- Analyses presented here are using from 72 pb^{-1} to 240 pb^{-1} of data
- Error on luminosity is ±6%
  - 1.6% due to CLC systematic error on CLC rate
  - 4.0% due to CLC acceptance sys
  - 3.8% due to limited by knowledge of pp inelastic cross section.



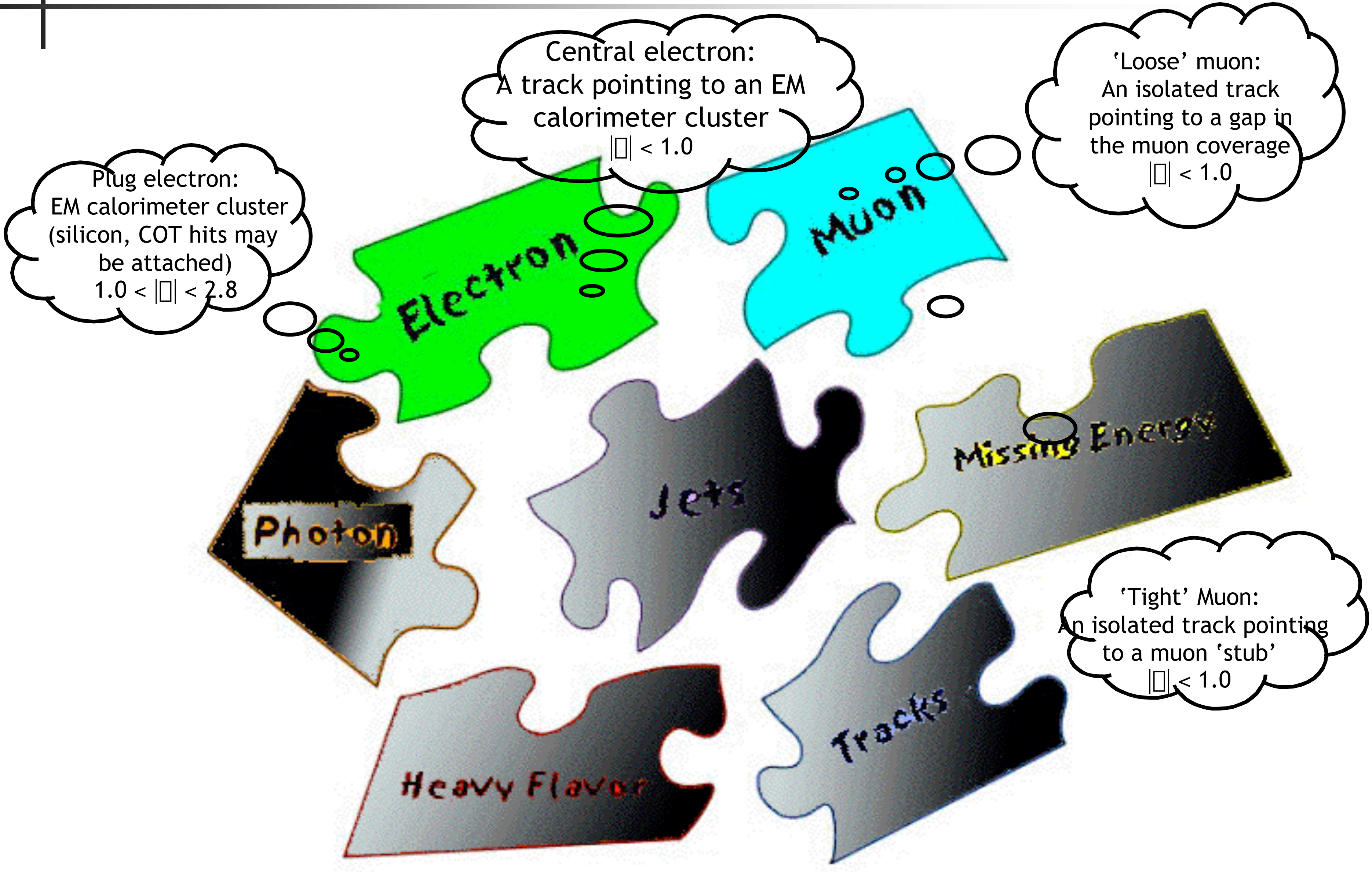
CDF Run II Detector

From Run I:
- Solenoid
- Central muon system
- Central calorimeter

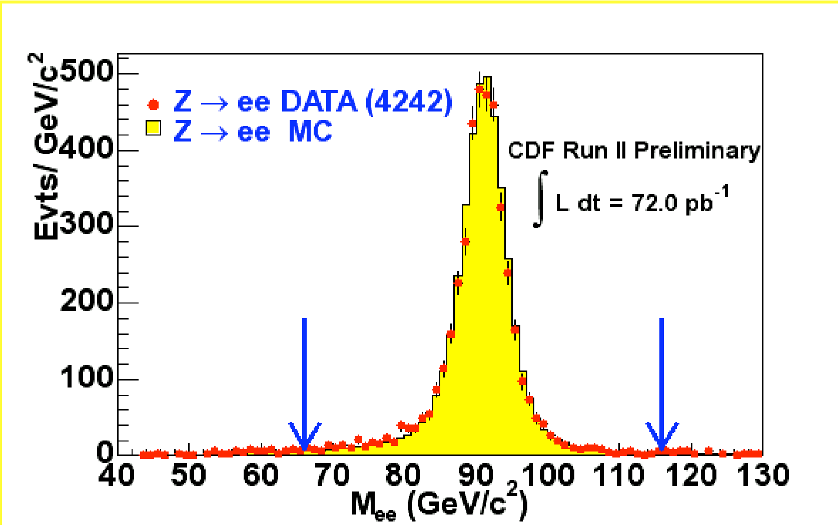


New For Run II:
- Front-end DAQ
- Trigger
  - Track (L1) and Displaced Track (L2)
- Silicon Tracker (8 Layers) ($|\eta|$ < 2.0)
- Central Outer Tracker ($|\eta|$ < 1.0)
- Plug Calorimeters (1.0 < $|\eta|$ < 3.6)
- Extended Muon Coverage ($|\eta|$ < 1.5, gaps filled in)

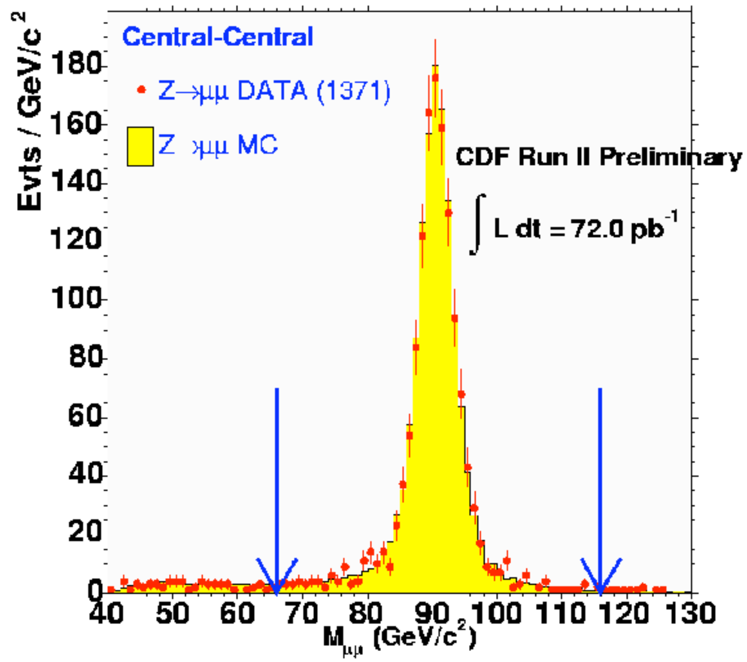
Electrons & Muons



Inclusive Z cross section



Full Acceptance



Very low backgrounds (QCD, $Z\rightarrow\tau\tau$, cosmics) : < 1%

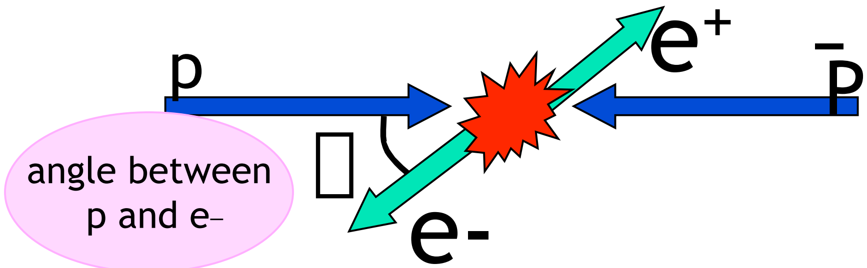
Important systematics : PDF's, Material Descriptions

$\sigma \cdot BR(Z\rightarrow ee) = 255.2 \pm 3.9(stat) \pm 5.5(sys) \pm 15.3(lum)$ pb

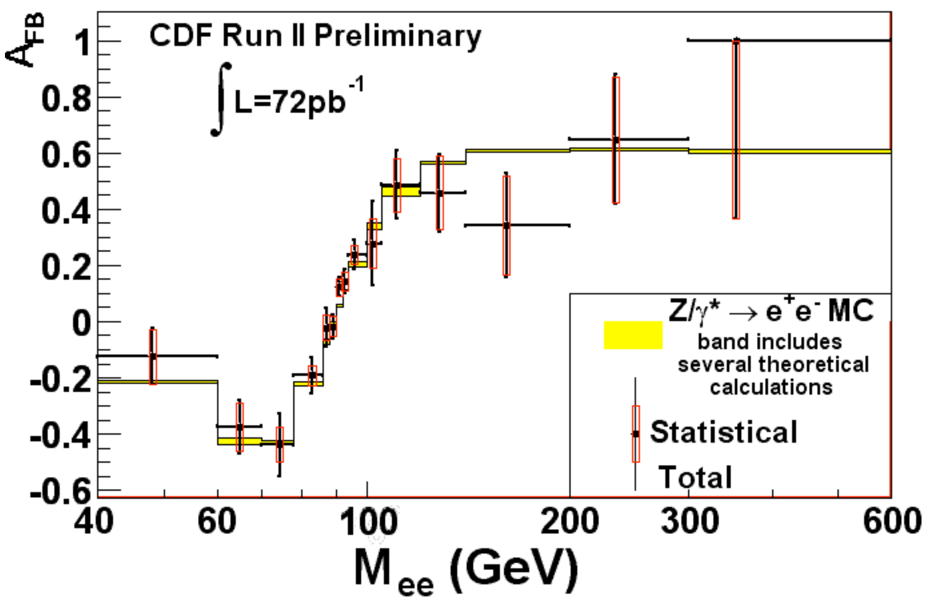
$\sigma \cdot BR(Z\rightarrow \mu\mu) = 248.9 \pm 5.9(stat)\ ^{+7.0}_{-6.2}(sys) \pm 14.9(lum)$ pb

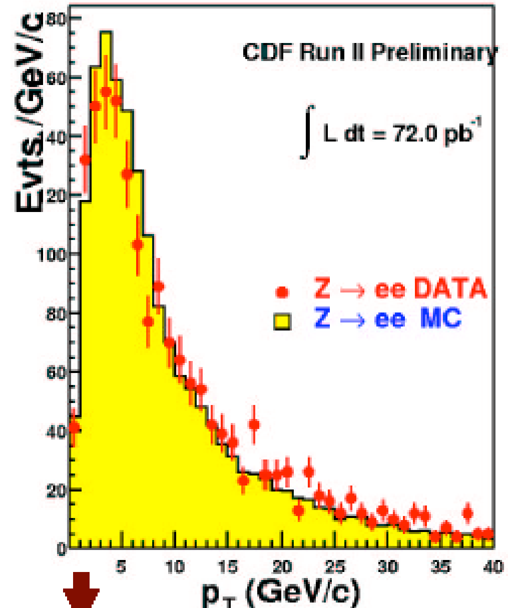
Extended measurements of cross section are well advanced

Drell-Yan Measurements



$$A_{fb} = \frac{\sigma(\cos\theta > 0) - \sigma(\cos\theta < 0)}{\sigma(\cos\theta > 0) + \sigma(\cos\theta < 0)}$$

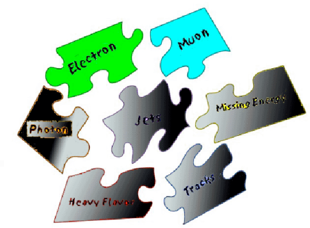


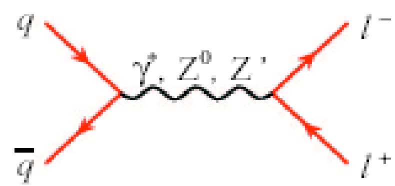


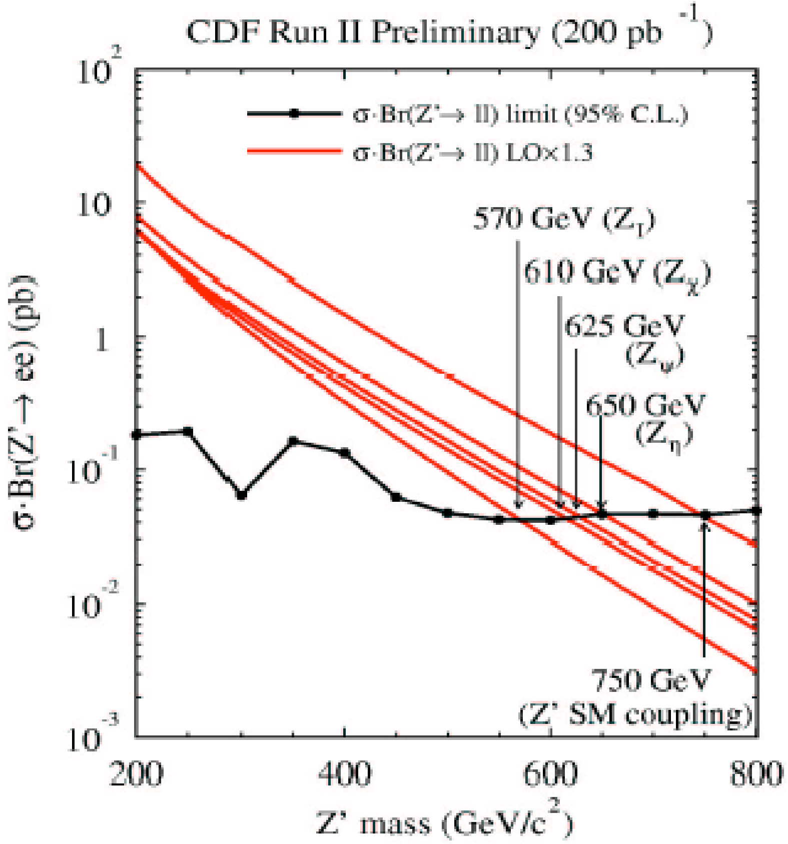
- Production properties : eventually feed into precision measurements (M_W)

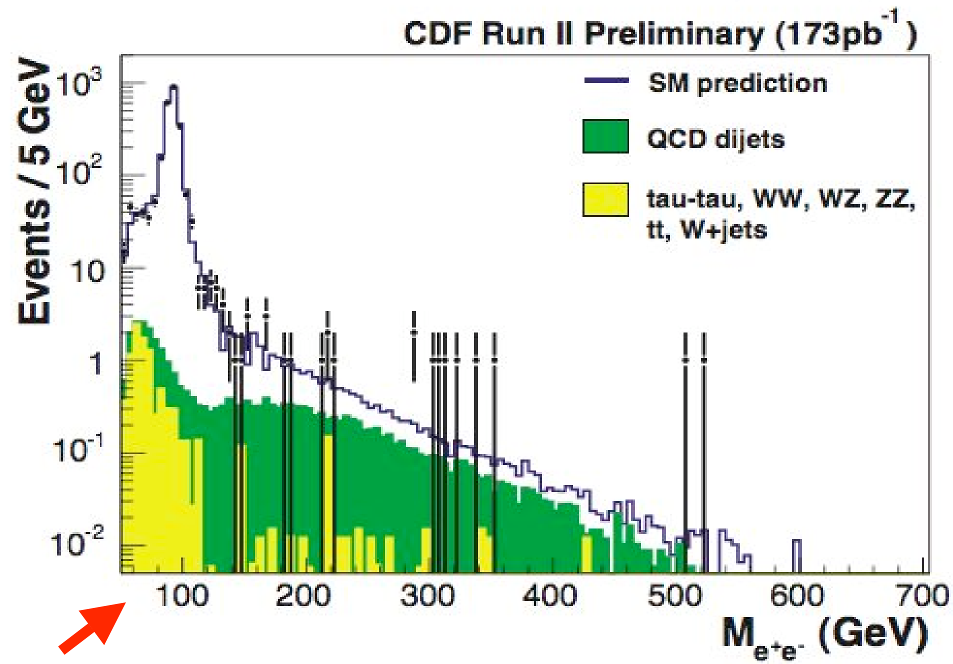
- $|\eta^e|<3.0$: using full detector coverage
- extract quark, lepton couplings & $\sin^2\vartheta_W$
- sensitive to new physics

Searches in dileptons



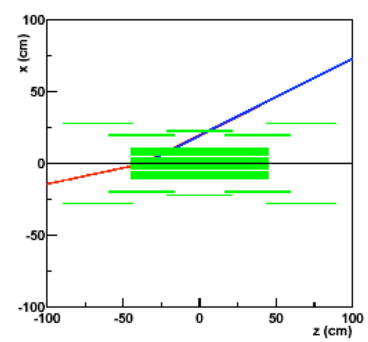


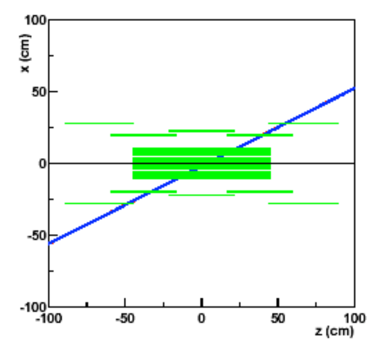




Forward electrons : $1.2 < |\eta| < 2.5$

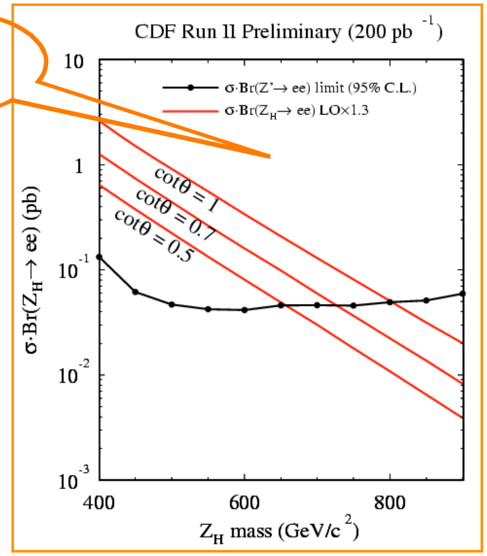
Calorimeter seeded Si tracking

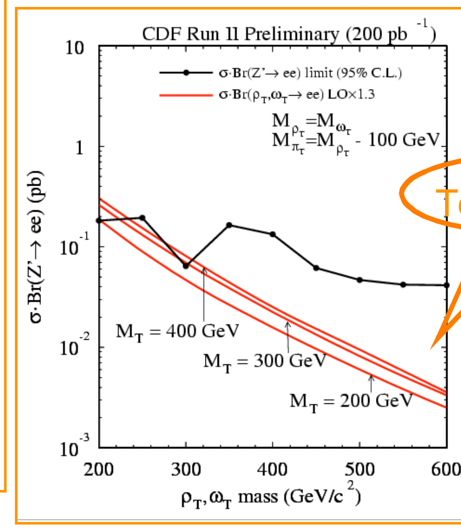




Searches in dileptons (cont'd)

Little Higgs

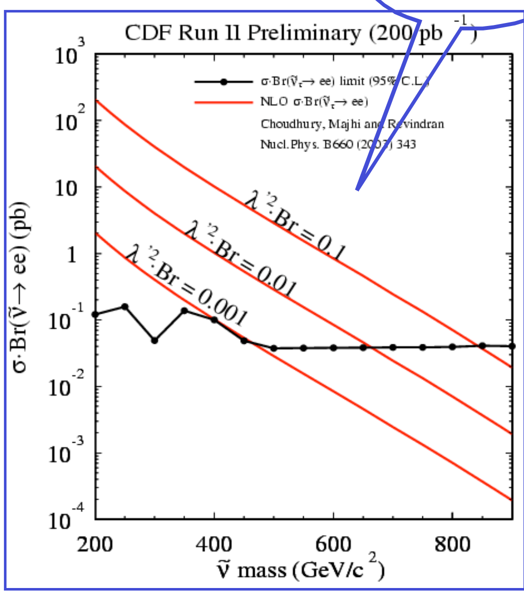


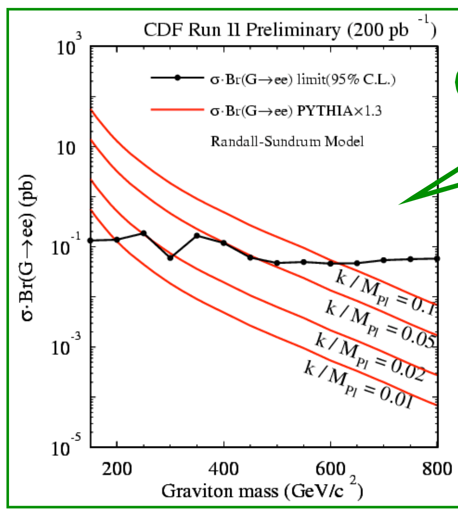


Technicolor

Calculate the acceptances for resonant states for 3 different spin assumption (0,1,2)

SUSY





Extra-Dimensions

- Randall-Sundrum graviton model

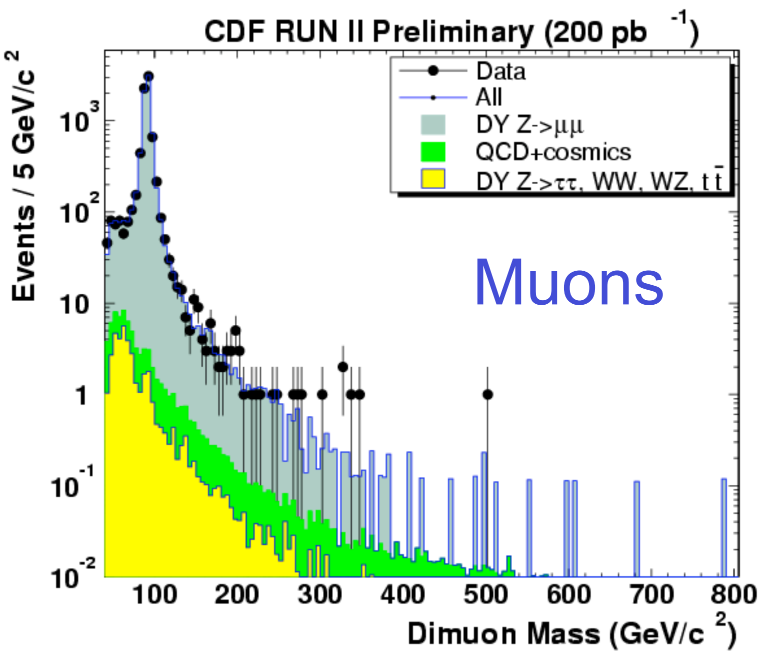
  4-dimensional metric multiplied by *warp* factor exponentially changing with the additional dimension

  Generating a large hierarchy does not require a large r_c

  The coupling of individual KK states to matter is set by the weak scale (parameters : M_G and $k/M_{P\,lanck}$)

  KK states can be observed as spin 2 resonances

Searches in dileptons (cont'd)

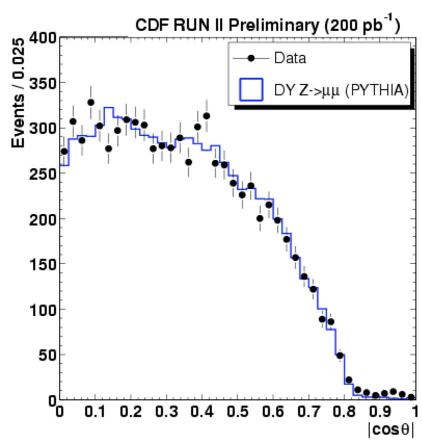


CDF Run II Preliminary

CDF run	Luminosity (pb^{-1})	$M_{Z',95\%C.L}$ (GeV/c^2)
Run IA	18.8	440
Run IB	88.6	575
Run IIA (summer '02)	16	275
Run IIA (winter '03)	72.0 (56.0 for CMX)	455
Run IIA (summer '03)	126 (110 for CMX)	585

CDF run	Luminosity (pb^{-1})	$M_{G,95\%C.L}$ (GeV/c^2) (k/Mpl = 0.1)
Run IIA (summer '02)	16	255
Run IIA (winter '03)	72.0 (56.0 for CMX)	370
Run IIA (summer '03)	126 (110 for CMX)	475

$$\cos\theta = \frac{2}{M\sqrt{M^2 + P_T^2}}\left(\ell_1^+\ell_2^- - \ell_1^-\ell_2^+\right)$$



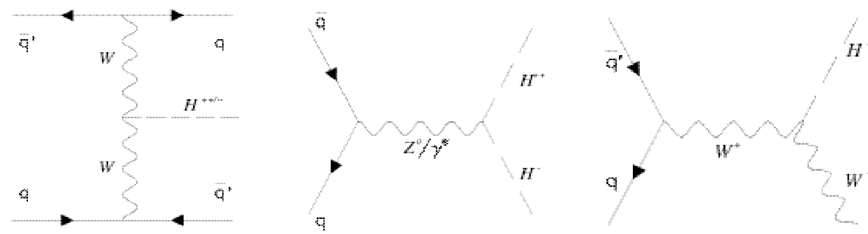
Model	Mass Limit at 95%C.L (GeV/c^2)		
	Run I	Run II (summer '03)	Run II (winter '04)
Z'_{SM}	590	585	In progress
Z'_{ψ}	495	465	
Z'_{χ}	500	455	
Z'_{η}	520	495	
Z'_{I}	480	425	

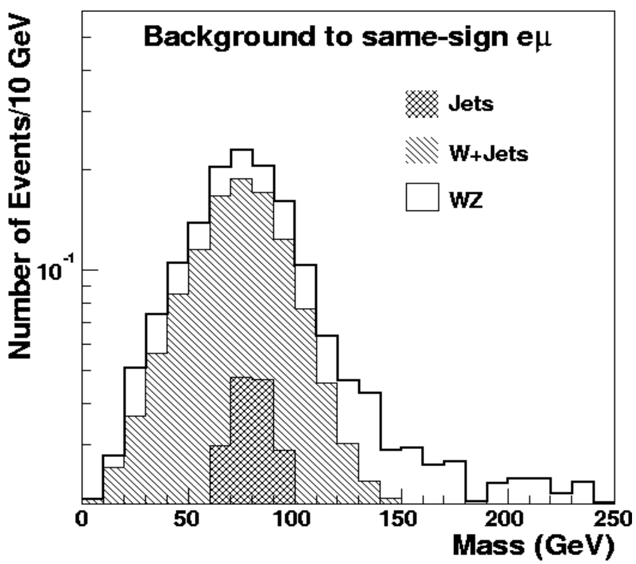
Search for doubly charged Higgs

Doubly charged Higgs are members of Higgs triplets occurring in several types of models

- extensions of the Higgs sector of the SM
- left-right symmetric models
- SUSY left-right symmetric models

At the TeVatron doubly charged Higgs can be paired-produced (Z exchange) or singly produced (WW fusion)

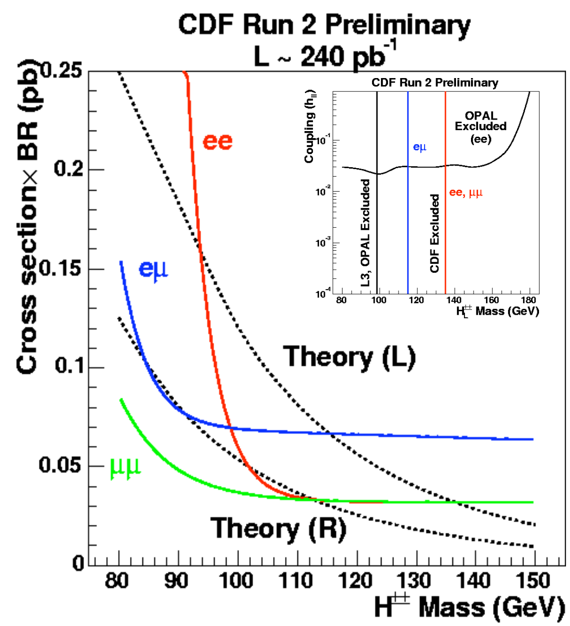




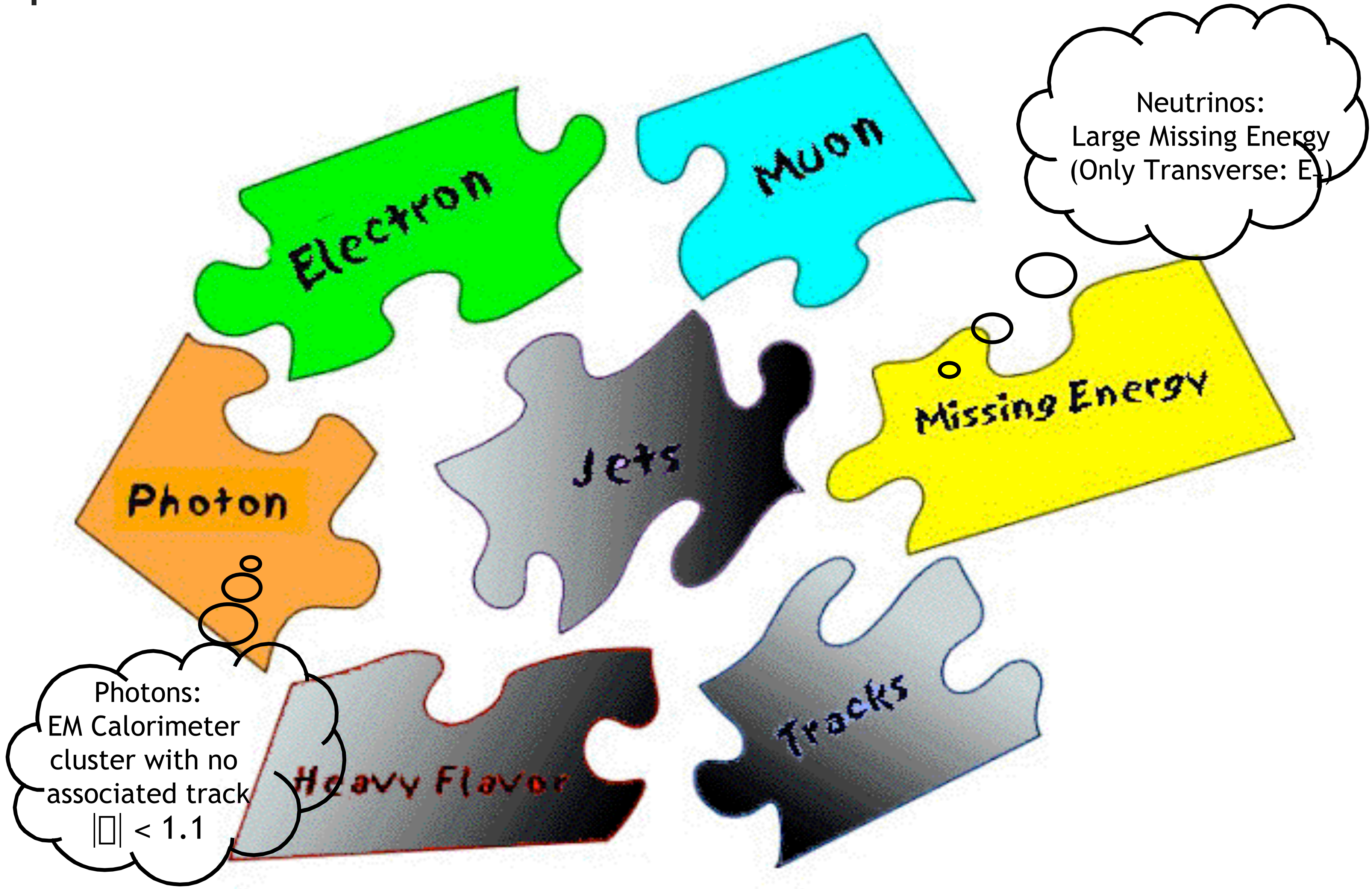
Same sign leptons signature

Very small background!

Decay Channels	# predicted Evts
ee	$1.8^{+0.8}_{-0.6}$
μμ	$0.8^{+0.6}_{-0.5}$
eμ	$0.9^{+0.4}_{-0.4}$



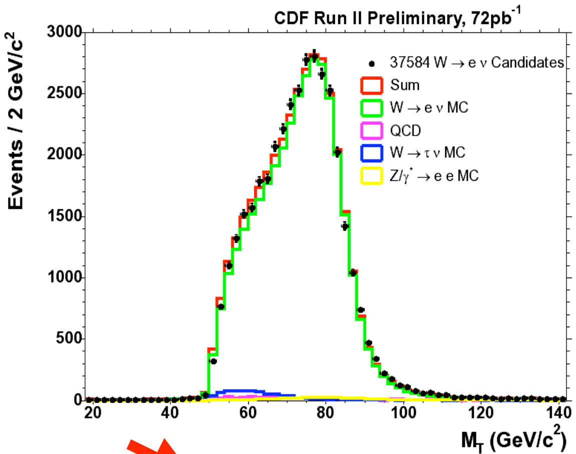
Photons & Neutrinos



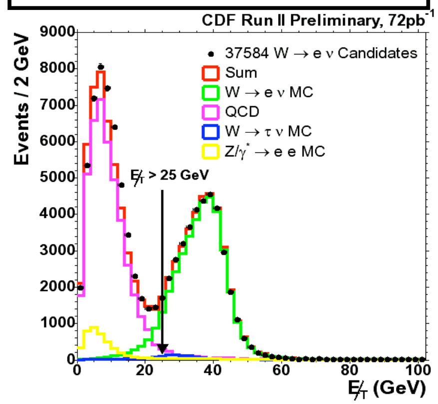
Inclusive W cross section

Control of background

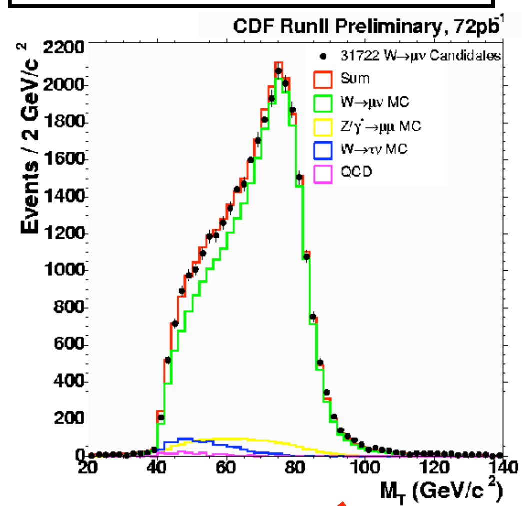
Transverse Mass - W→ eν



Missing Transverse Energy



Transverse Mass - W→ μν



$$\sigma \cdot \mathrm{BR}(p\bar{p} \to W \to e\nu) = 2782 \pm 14(stat)^{+61}_{-56}(syst) \pm 167(lum)\,\mathrm{pb}$$

$$\sigma \cdot \mathrm{BR}(p\bar{p} \to W \to \mu\nu) = 2772 \pm 16(stat)^{+64}_{-60}(syst) \pm 166(lum)\,\mathrm{pb}$$

Backgrounds (QCD, W→τν, Z, cosmics) : 6% (e), 11% (μ).
Important systematics : PDF's, Energy Scales, Material Description

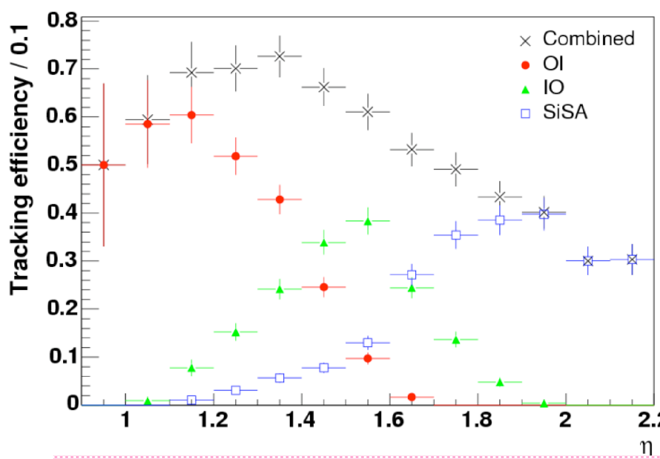
Inclusive W cross section (cont'd)

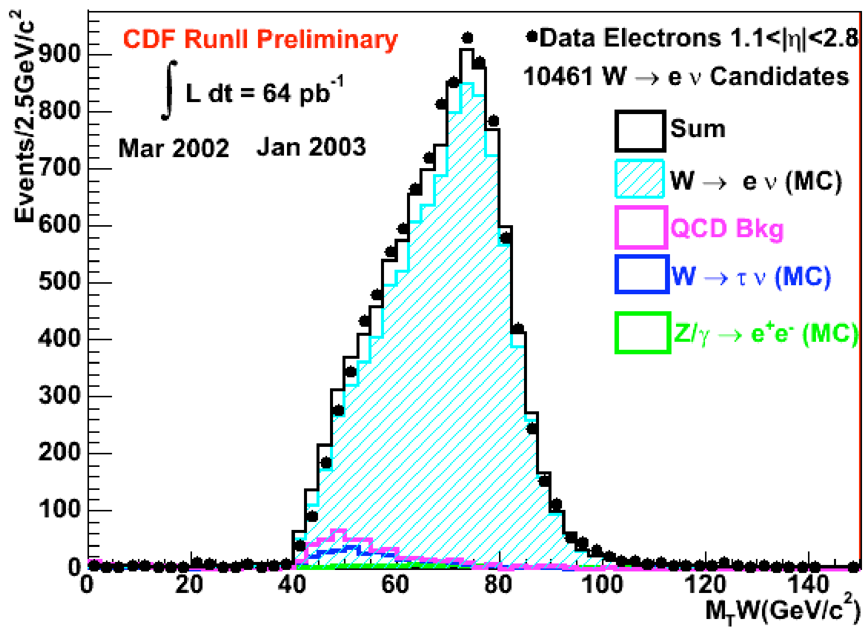
Following the same strategy pursued in the $|\eta| < 1$ region, full tracking is used in the forward region

EM cluster is matched to a 3D track reconstructed using the Silicon detector only in the region $1 < |\eta| < 2.8$

- Two 3-D hits & vertex seed silicon track (SISA)
- OI seeded by COT hits
- IO attaches COT hits to SISA

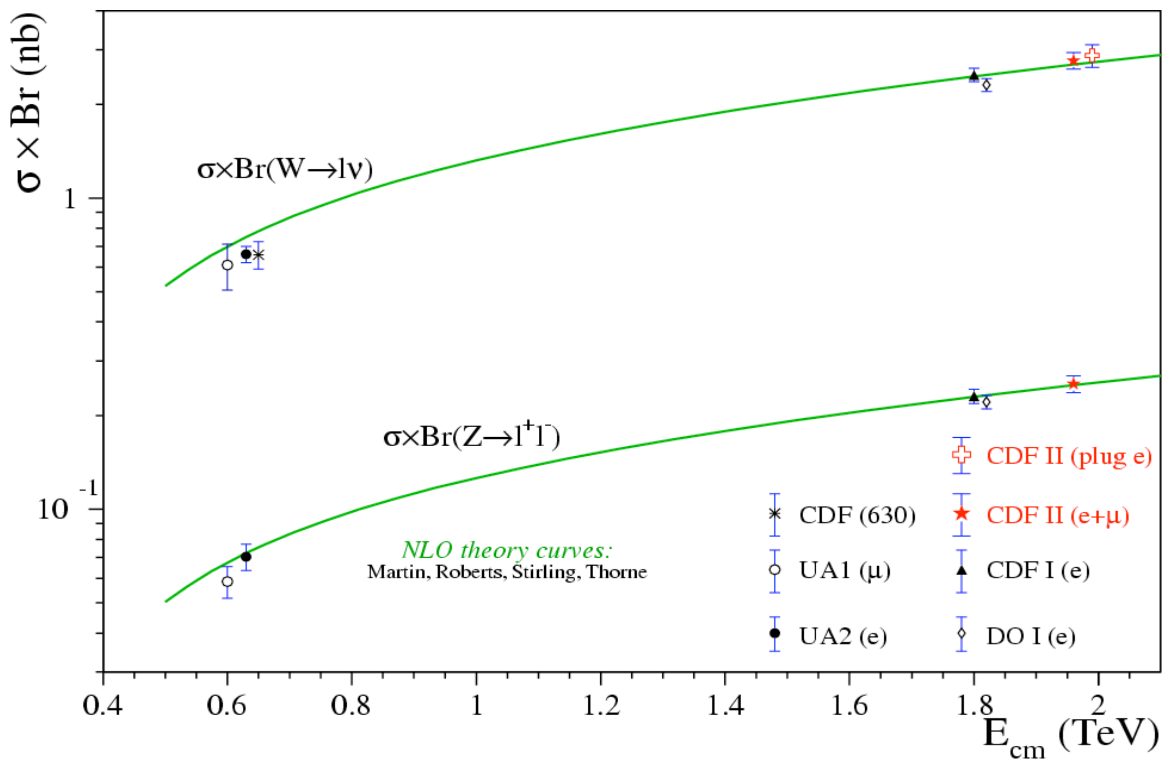
Tracking Efficiency





$\sigma \times BR(W \to e\nu) = 2874 \pm 34\ (stat) \pm 167\ (sys) \pm 172\ (lumi)$ pb

Summary and X-Sections Ratio



$$R = \frac{\sigma \cdot Br(p\bar{p} \to W \to \ell\nu)}{\sigma \cdot Br(p\bar{p} \to Z \to \ell^+\ell^-)} = \frac{\sigma(p\bar{p} \to W)}{\sigma(p\bar{p} \to Z)} \times \frac{\Gamma_Z}{\Gamma_Z(\ell^+\ell^-)} \times \frac{\Gamma_W(\ell\nu)}{\Gamma_W}$$

$$R_e = 10.86 \pm 0.18_{(stat)} \pm 0.16_{(syst)}$$

$$R_\mu = 11.10 \pm 0.27_{(stat)} \pm 0.17_{(syst)}$$

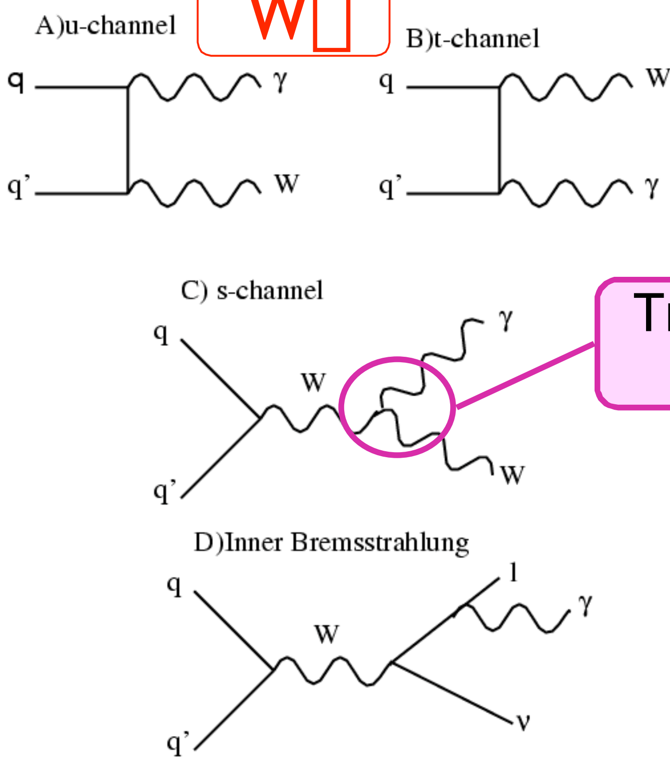
$$R = 10.94 \pm 0.15_{(stat)} \pm 0.13_{(syst)}$$

The combined ratio is precise at 1.8% independent on the luminosity

Di-boson Signals

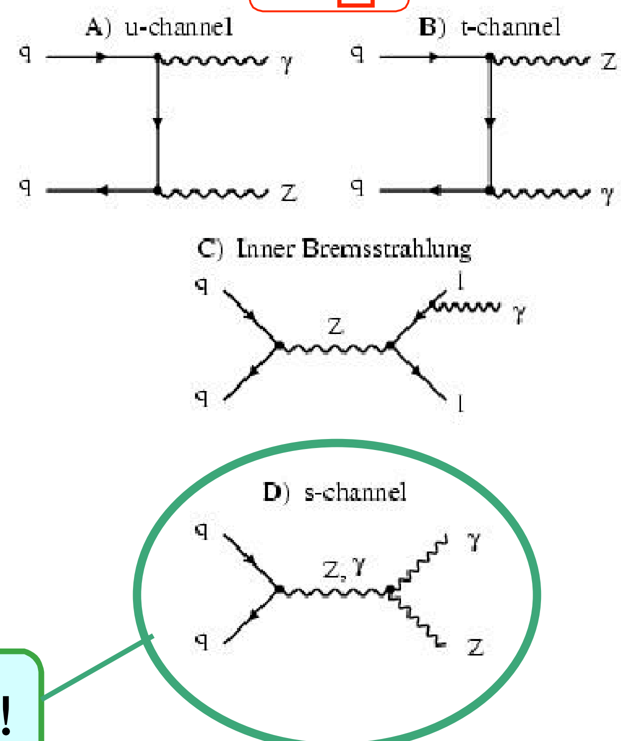
Test of gauge couplings (as predicted by the SM) and a window on new physics

W□



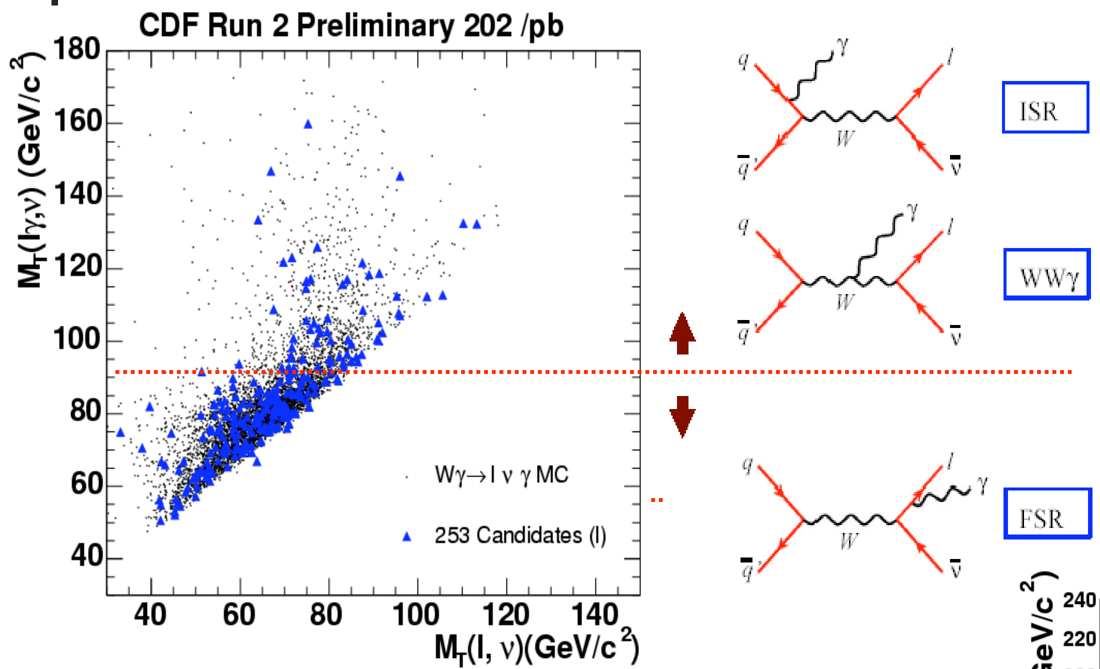
Triple Boson Coupling

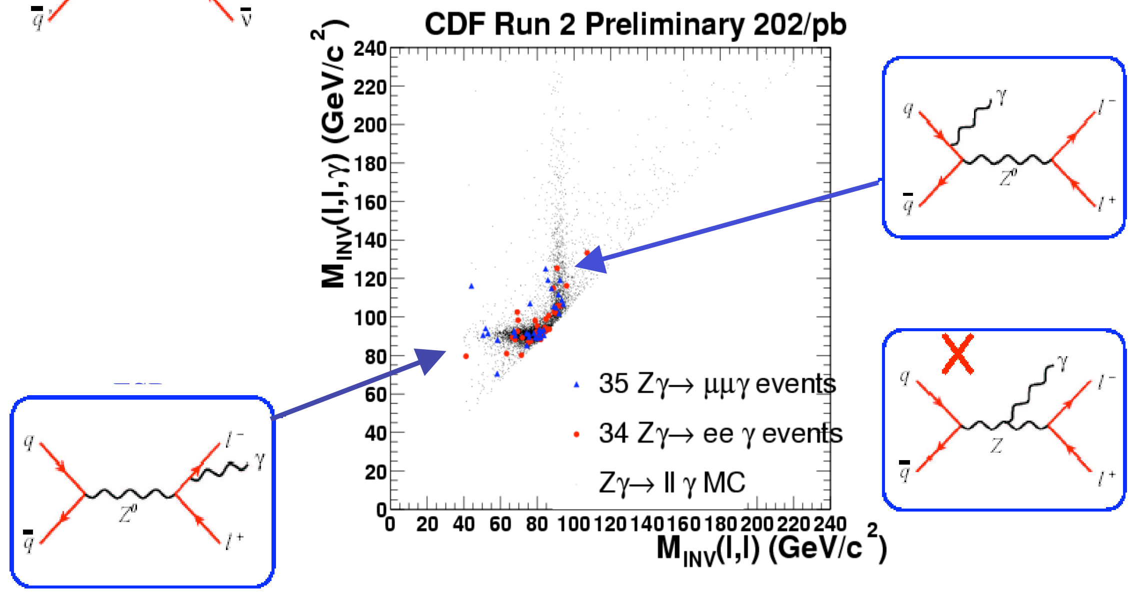
Z□



Non SM!

W□and Z □


CDF Run 2 Preliminary 202 /pb
$M_T(l\gamma,\nu)$ (GeV/c^2)
$M_T(l,\nu)$(GeV/c^2)
W$\gamma \rightarrow$ l ν γ MC
253 Candidates (l)
ISR
WWγ
FSR

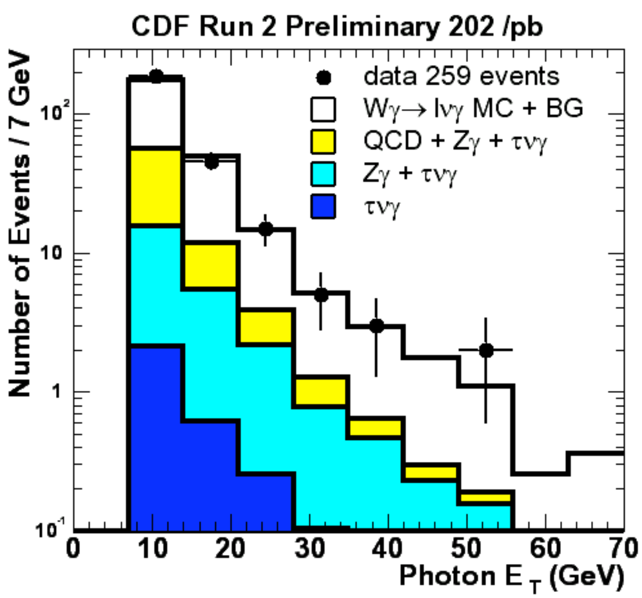

CDF Run 2 Preliminary 202/pb
$M_{INV}(l,l,\gamma)$ (GeV/c^2)
$M_{INV}(l,l)$ (GeV/c^2)
35 Z$\gamma \rightarrow$ $\mu\mu\gamma$ events
34 Z$\gamma \rightarrow$ ee γ events
Z$\gamma \rightarrow$ ll γ MC

W□

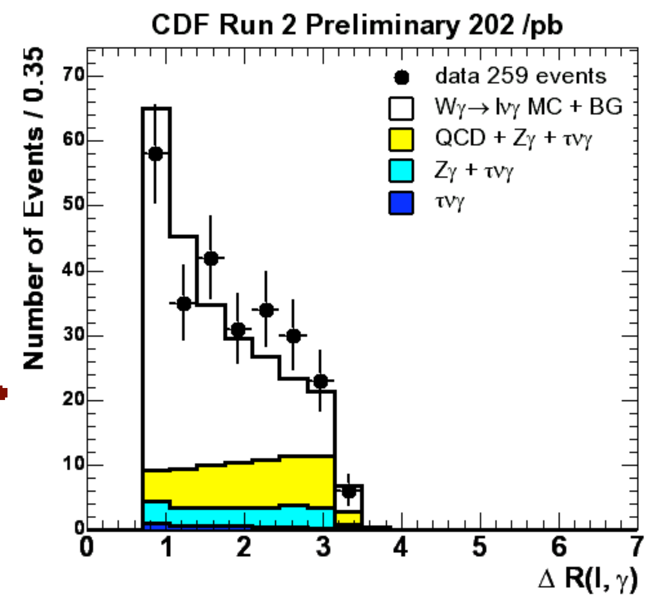
- First select W→lν events :
  - Electrons : E_T>25 GeV; missing−E_T>25 GeV
  - Muons : E_T>20 GeV; missing−E_T>20 GeV
- Then look for additional photons :
  - E_T(photon) > 7 GeV
  - $|\eta^\gamma| < 1.1$
  - $\Delta R(l,\gamma) > 0.7$

□(W□)□BR(W□ l□) = 19.7
± 1.7 (stat) ± 2.0 (sys)
± 1.1 (lumi) pb

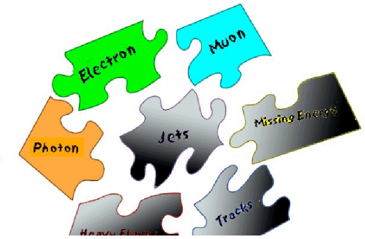
For E_T(□) > 7 GeV and □R(l, □) > 0.7:
□(W□)□BR(W□ l□) (Theory) = 19.3 ± 1.4



data well described over all photon E_T's and separations

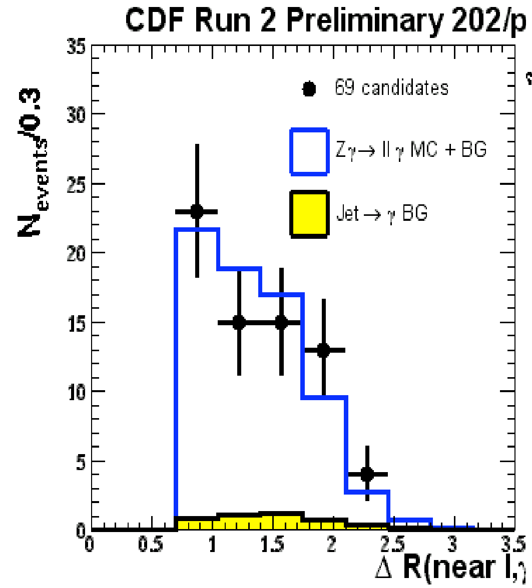


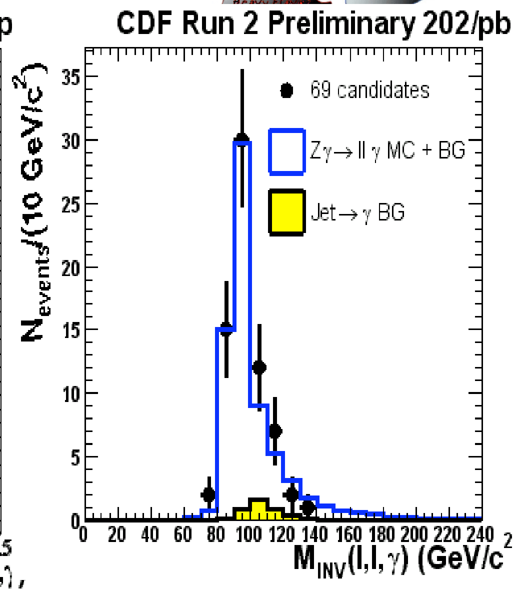
Zγ

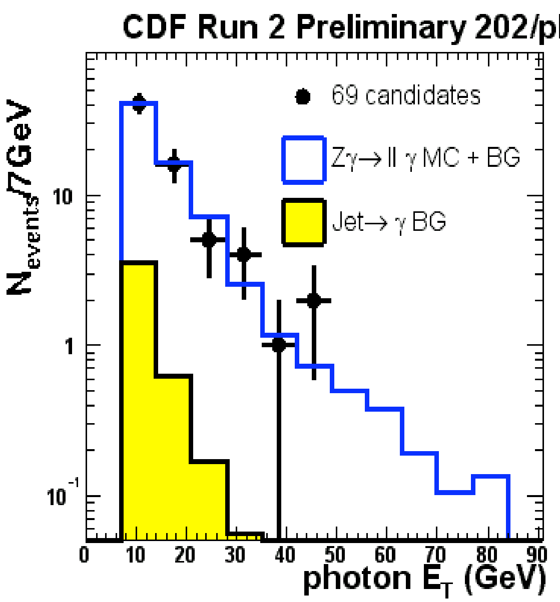


$\sigma(Z\gamma)\cdot BR(Z\to ll) = 5.3$
$\pm$ 0.6 (stat) $\pm$ 0.4 (sys)
$\pm$ 0.3 (lumi) pb

For $E_T(\gamma) > 7$ GeV and $\Delta R(l,\gamma) > 0.7$:
$\sigma(Z\gamma)\cdot BR(Z\to ll)$ (Theory) = 5.4 $\pm$ 0.4

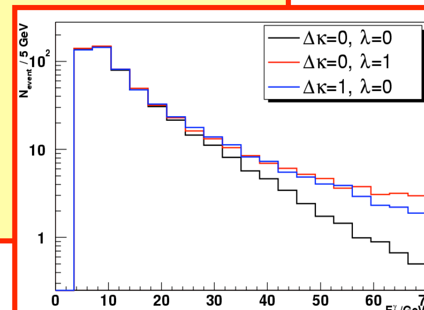






Now V+γ cross-sections well established, we are:

- optimizing sensitivity to anomalous coupling and new physics
- testing the Standard Model in ways unique to the TeVatron (e.g. observing RAZ in W γ production)



Excited electrons

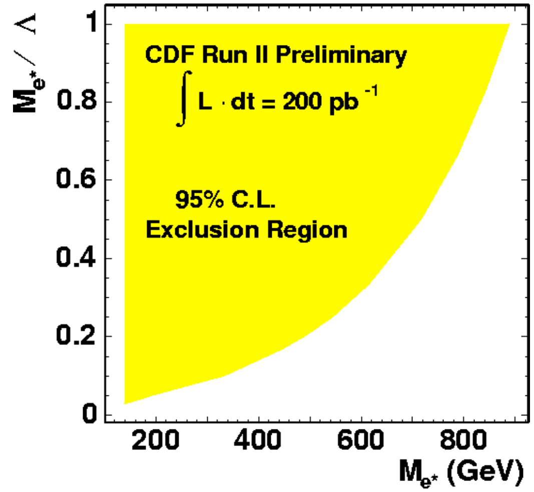
Observation of excited states of quarks and leptons might confirm the hypothesis that they are not elementary particles , but composite states

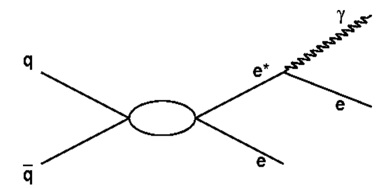
CDF searched for excited electron (e^*) using high pt electron data (L=200 pb^{-1})

- Select events with eeγ in the final state
- Look for resonance in M($e\gamma$)
- SM backgrounds :

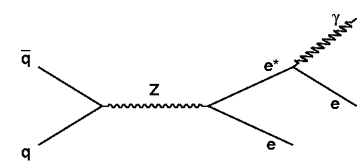
  Zγ+ DY , Z+jets, WZ, Multi-jets, $\gamma\gamma$+jets, …

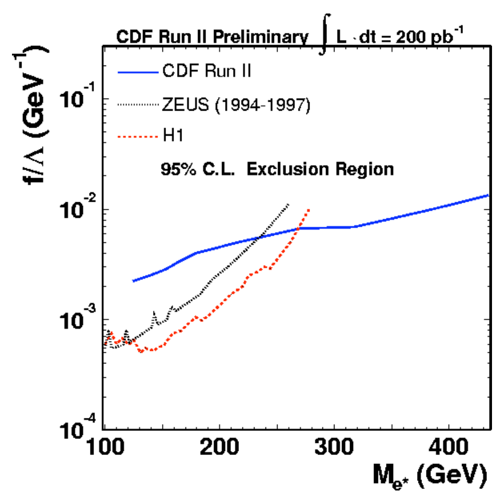
Expect 3 events, observe 3 events





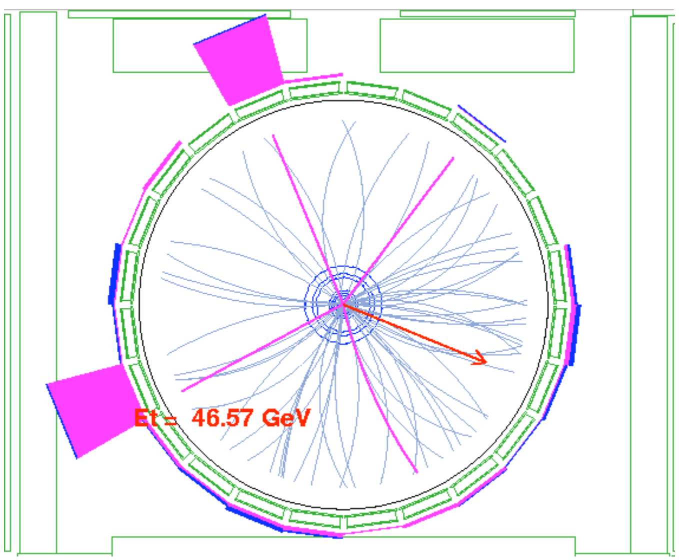
At Tevatron, e^* can be produced via contact interactions or gauge mediated interactions

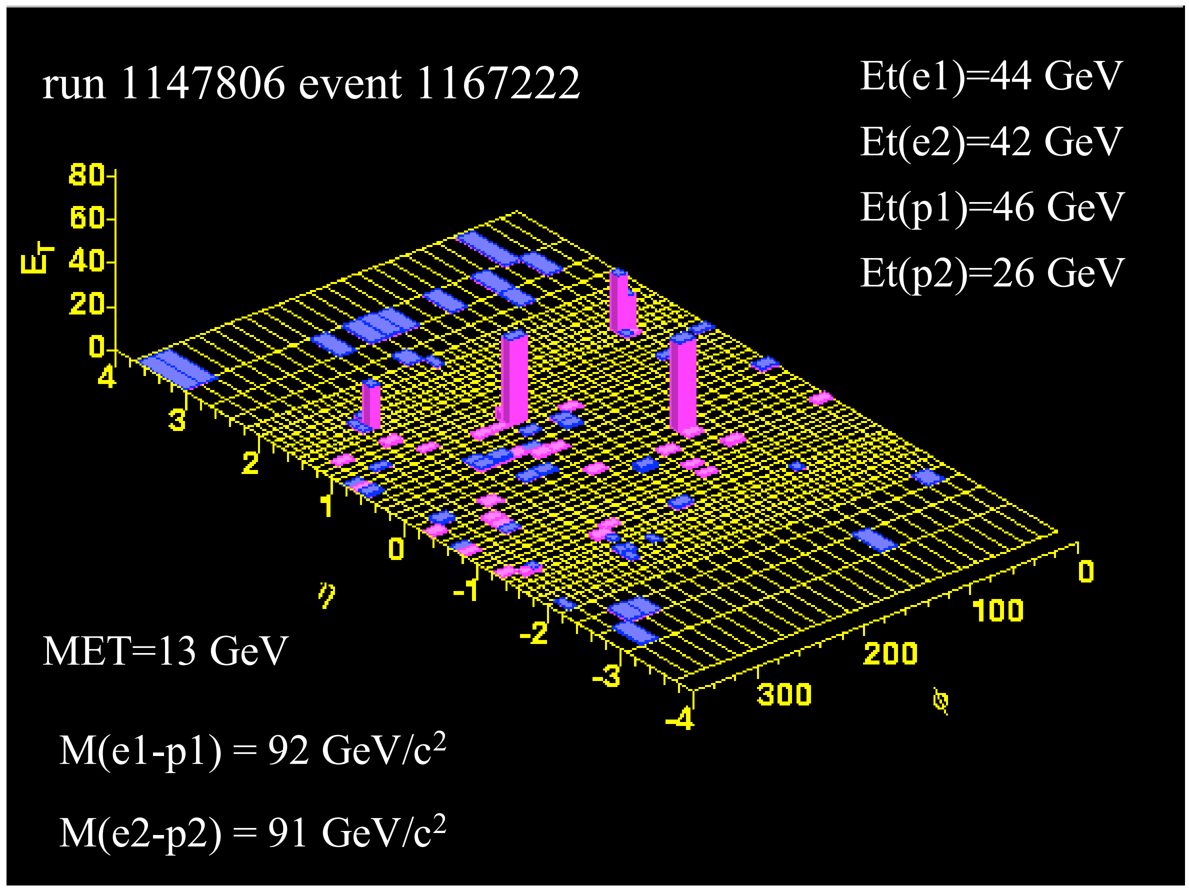




Excited electrons

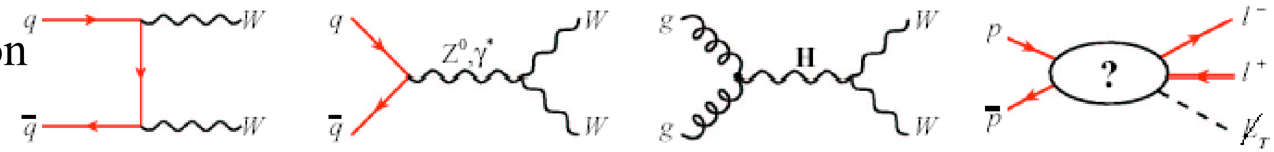
- 4 EM candidates
    - Could be ZZ event!





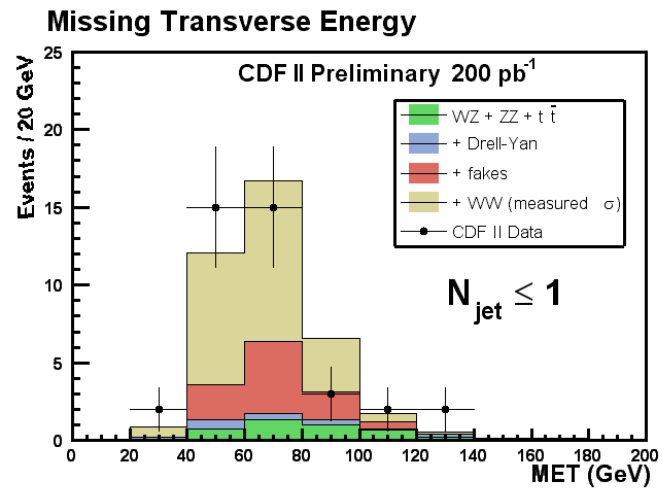
WW

Further step towards limits on anomalous WWZ, WWγ coupling

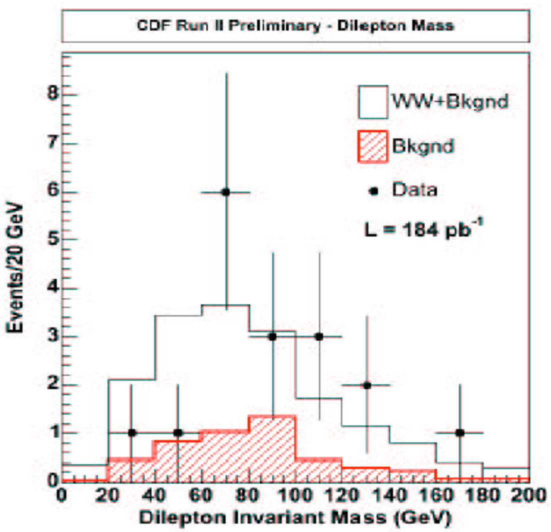


- Two isolated E_T>20 GeV leptons (e or μ) .
- Missing−E_T > 25 GeV.
- Remove events consistent with Z decay.
- Remove top background by requiring no additional jets.
- Remove fakes by requiring opposite sign.

Tight lepton selection complemented by lepton + tracks selection



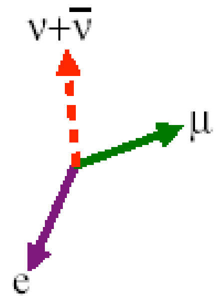
Larger fakes contamination and uncertainty



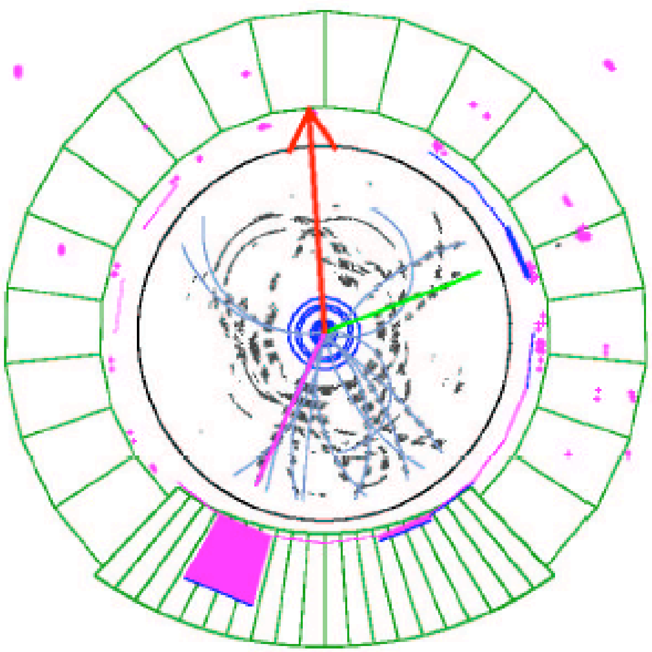
σ_{WW} = 19.4 ± 5.1 (stat) ± 3.5 (sys) ± 1.2 (lumi)

$$\sigma^{WW}_{meas} \;=\; 14.3^{+5.6}_{-4.9}\ (\mathrm{stat})\ \pm\ 1.6\ (\mathrm{syst})\ \pm\ 0.9\ (\mathrm{lum})\ \mathrm{pb}$$

WW



- $e\mu$ channel has little Standard Model background
- Signal/Background ≈ 4

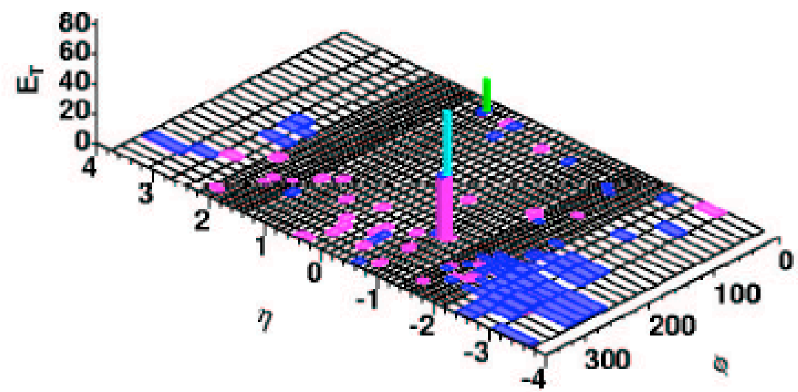


Run 155364 Event 3494901 : $WW \to e^+\nu_e\mu^-\bar{\nu}_\mu$ Candidate

$p_T(e) = 42.0$ GeV/c; $p_T(\mu) = 20.0$ GeV/c; $M_{e\mu} = 81.5$ GeV

$\not{E}_T = 64.8$ GeV; $\Phi(\not{E}_T) = 1.6$

$\Delta\Phi(\not{E}_T$, lepton$) = 1.3$; $\Delta\Phi(e,\mu) = 2.4$; Opening-Angle(e,μ)=2.6



SUSY searches in diphoton + $\not{E}_T$

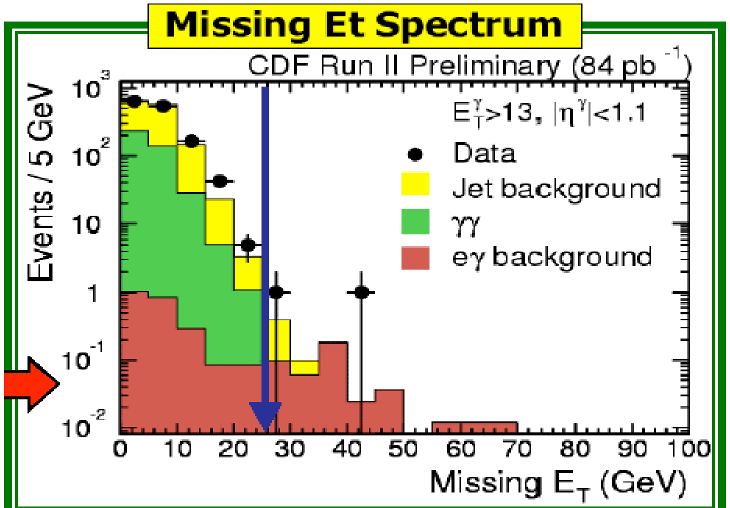
GMSB scenario
NLSP = $□^0_1$□ □G

$p\bar{p}$ □ (X □) $□^0_1$ $□^0_1$ → 2 □+ $\not{E}_T$

Sample selection (84 pb^{-1})

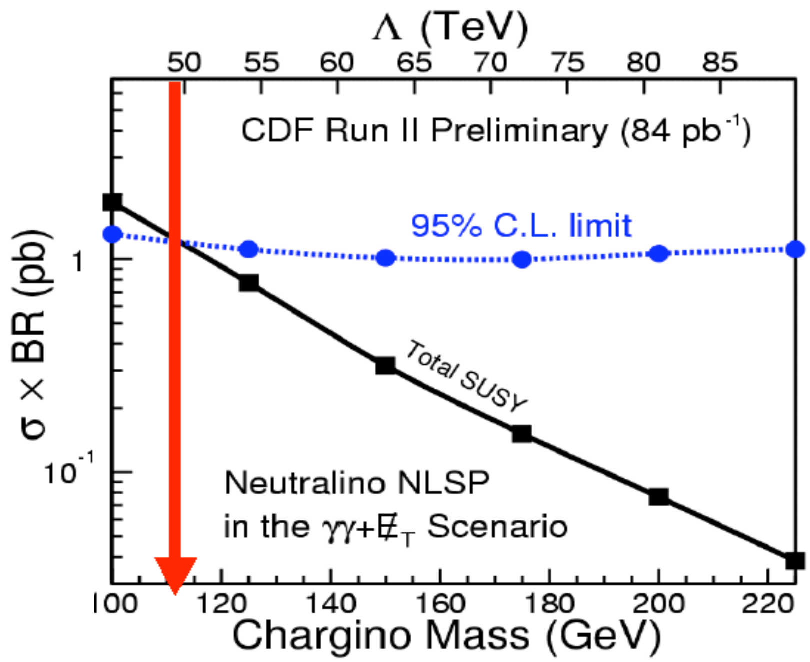
- 2 central photons E_T > 13 GeV
- cosmic rays and beam halo rejection

Missing Et Spectrum



For Missing Et>25GeV

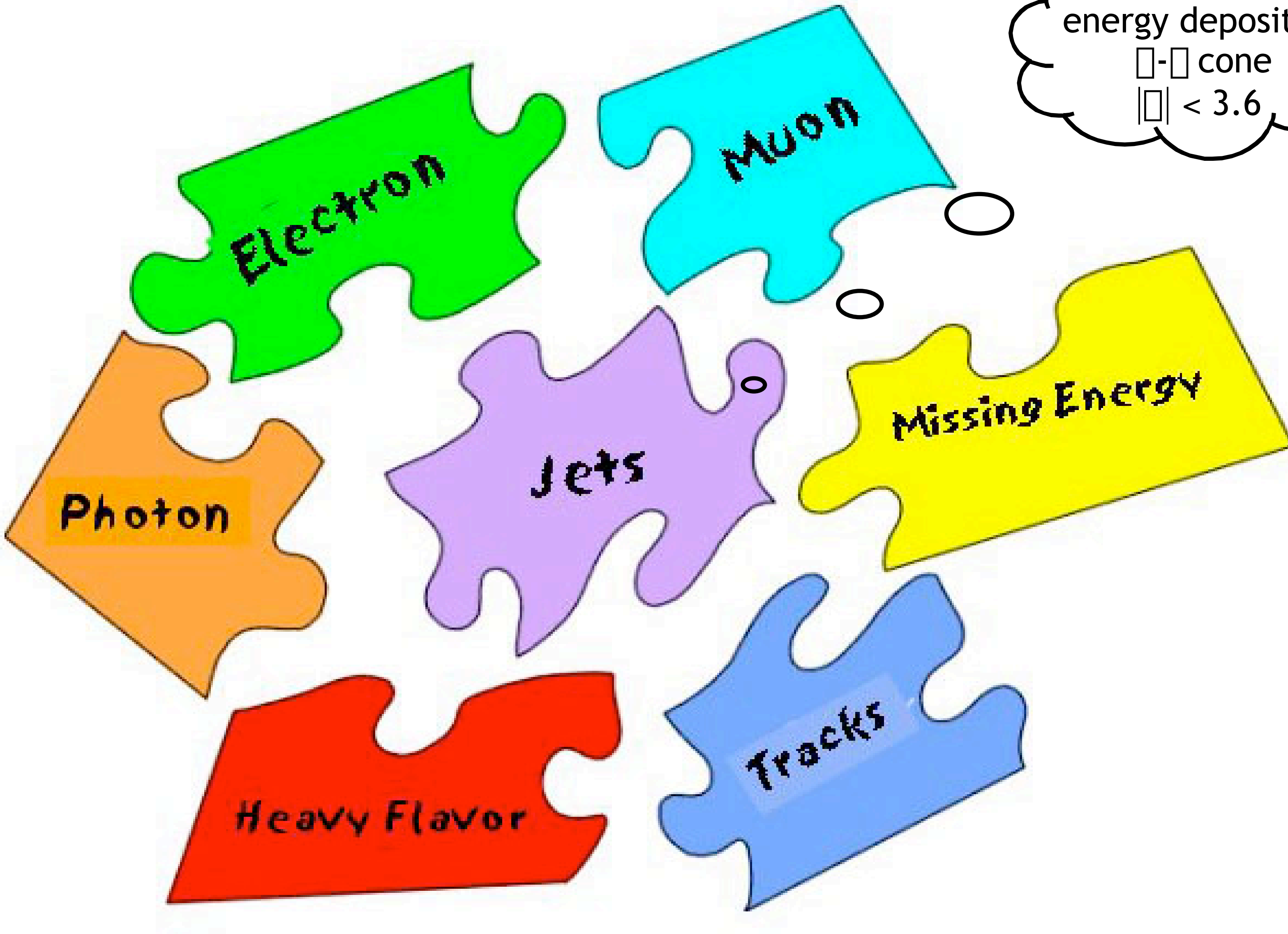
Expected background: 2±2
Observed: 2



M(C_1) > 113 GeV @ 95% C.L.

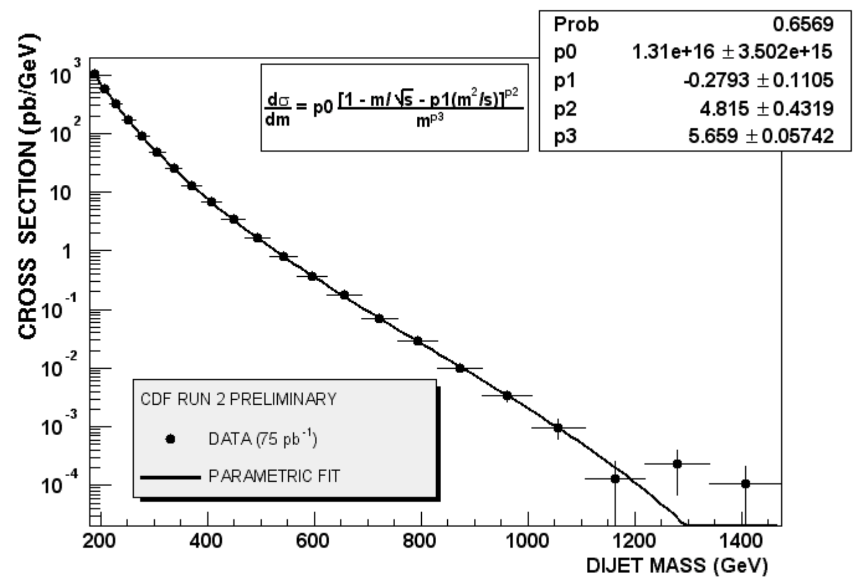
Jets

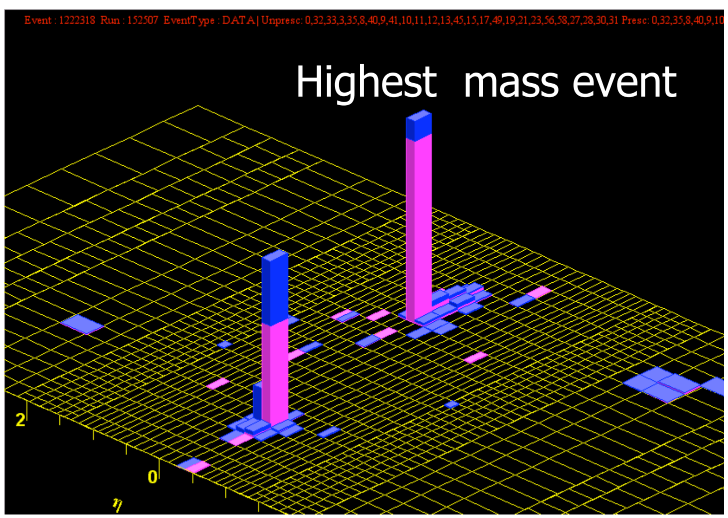
Jets:
energy deposit in
η-ϕ cone
$|\eta| < 3.6$



Search for Mass Bumps in Dijets

- Inclusive jet samples
- MET/ □E_T < 6 and □E < 2.2 TeV
- 2 highest E_T jets selected
- fit of the mass spectrum with a simple background parameterization and search for bumps comparable with the mass resolution.



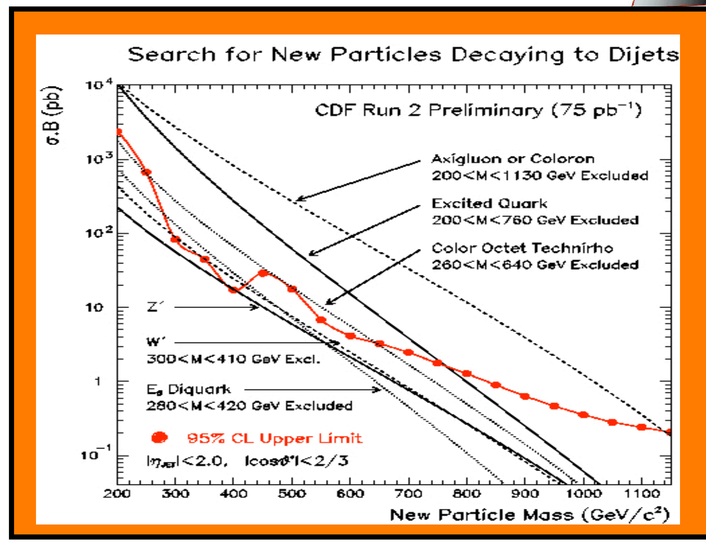


no significant evidence for a new particles…yet

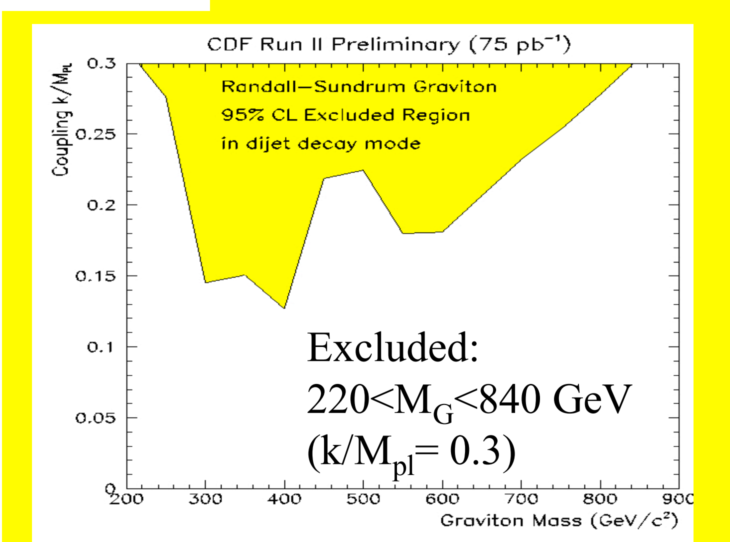
Run 152507 event 1222318
Dijet Mass = 1364 GeV/c^2
cos q* = 0.30
z vertex = -25 cm

Search for Mass Bumps in Dijets

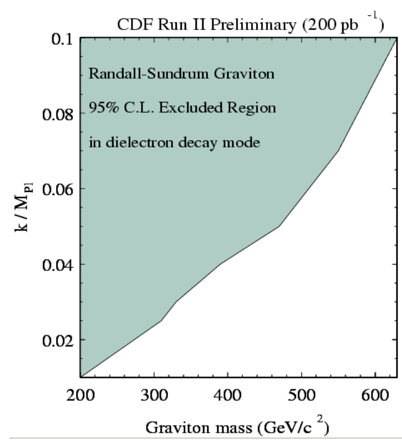
Particle	95% C.L. GeV
Axion/Coloron	200<M<1130
Excited Quark	200<M<760
E6 diquark	280<M<420
W'	300<M<410
Technirho	260<M<640

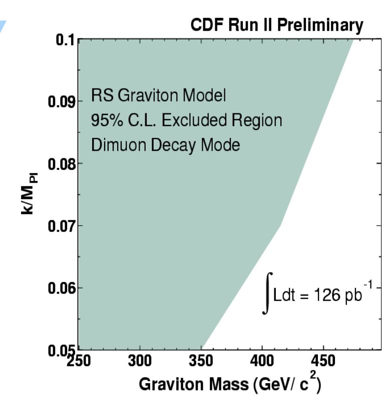


ExtraDimensions



Complementary to dilepton search



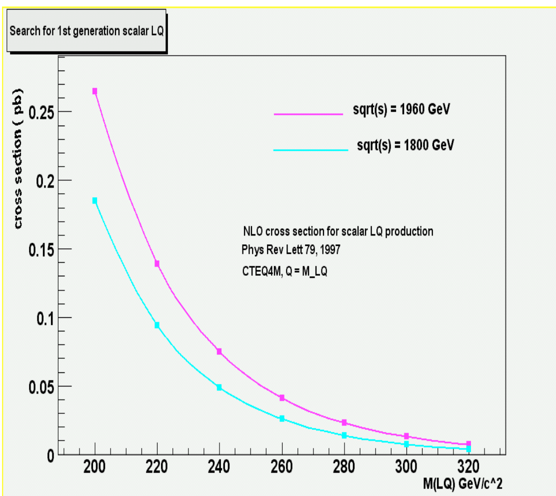


Leptoquarks

Several extension of the SM model (GUTS, Technicolor, Compositeness, RPV-SUSY) assume an additional symmetry between leptons and quarks

Carry both lepton (L) and baryon (B) numbers
Couple to quark and lepton of the same generation

3 generations

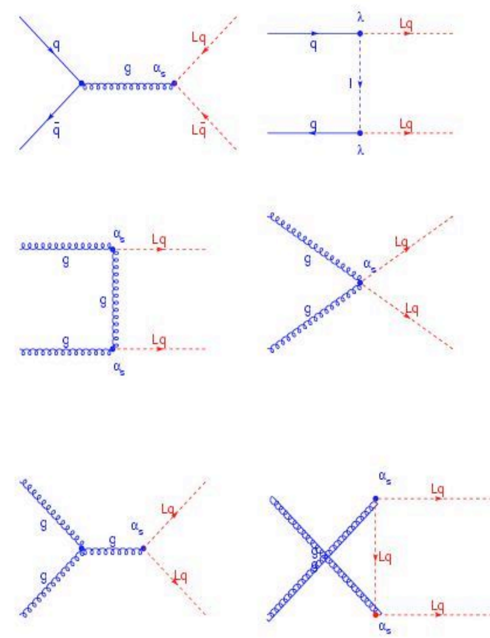


30% increase in cross section at RunII

At the TeVatron they are pair produced

Their decay is controlled by β = BR (LQ$\to$ lq)

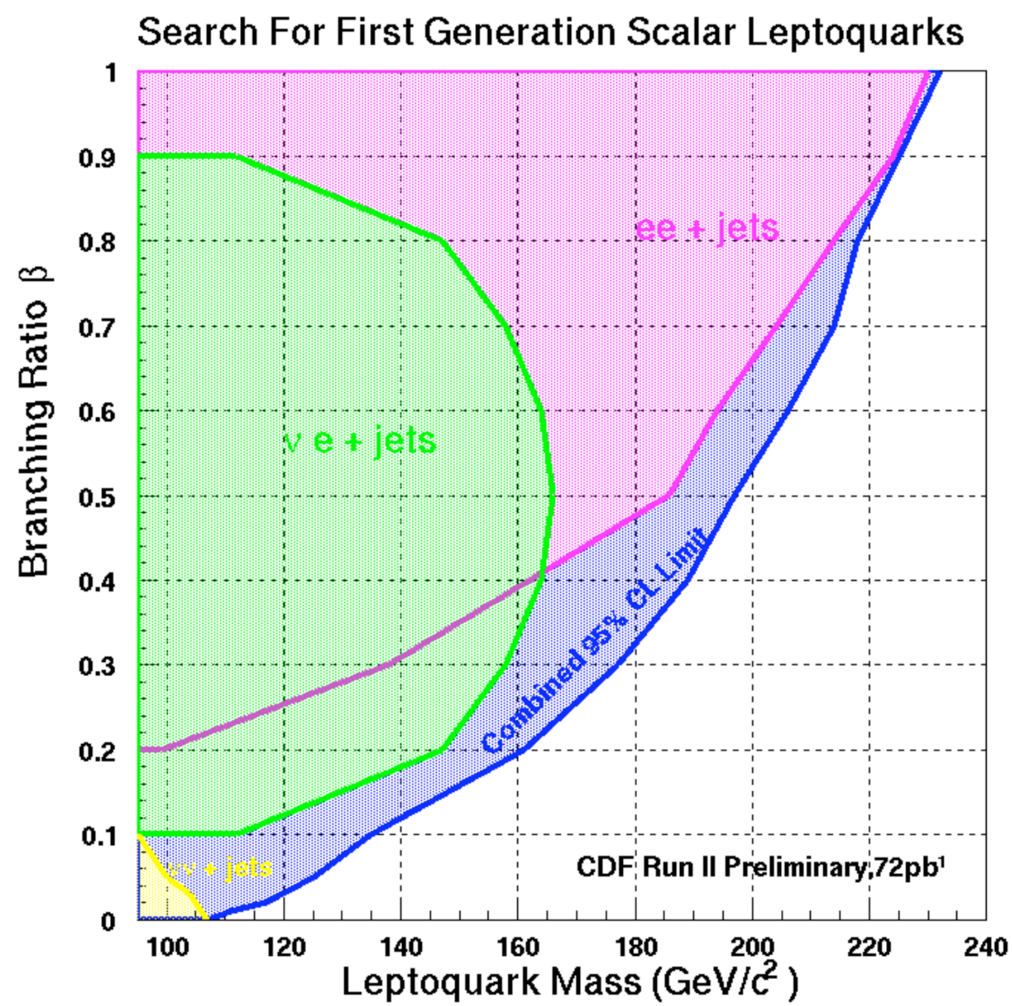
Experimental signature: high P_T isolated lepton(s) and/or $\not{E}_T$ + 2 jets



1st generation LQ

Signature:
2 electrons and 2 jets
electron, $\not\!\!E_T$ and 2 jets
$\not\!\!E_T$ and 2 jets

111GeV/c^2 (β =0.01)
124GeV/c^2 (β =0.05)
135 GeV/c^2 (β =0.1)
161 GeV/c^2 (β =0.2)
197 GeV/c^2 (β =0.5)
232 GeV/c^2 (β =1.0)



2nd generation LQ

Signature: 2 muons and 2 jets

β =BR(LQ$\rightarrow\mu$q) = 1

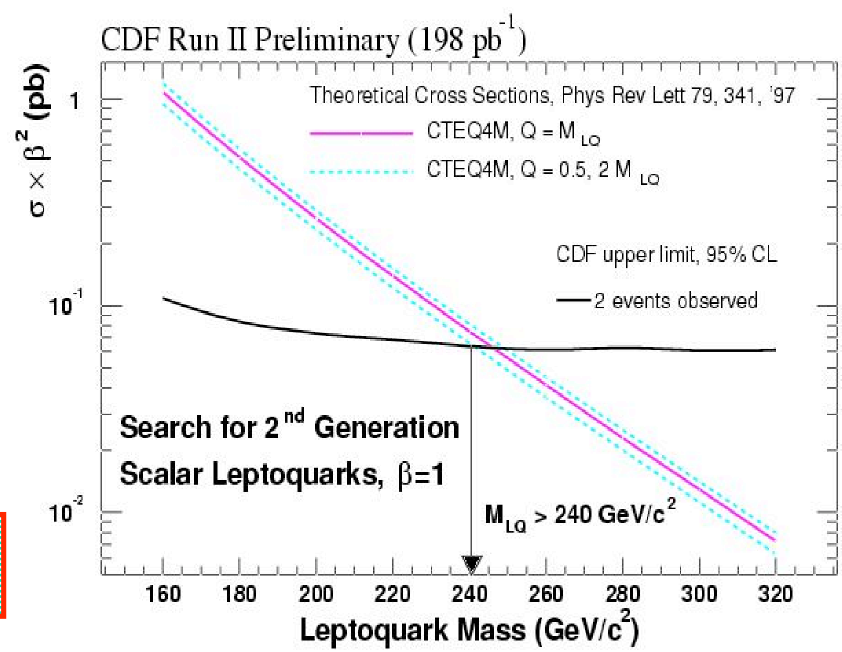
Tight μ's selection complemented by μ + track selection

Background:
- Z + 2 jets
- top
- QCD fakes

expected 3.15 ± 1.17

2 events seen after analysis cuts

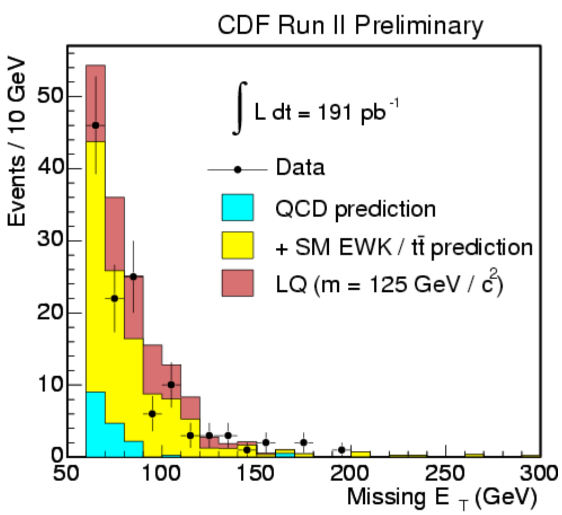
M(LQ) > 240 GeV/c^2 @ 95% C.L.



LQ search in $\nu\nu$jj

Signature: Large MET and 2 jets

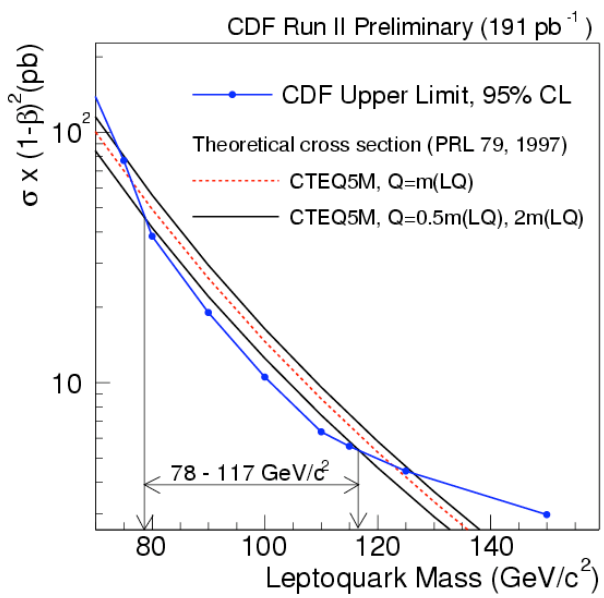
β' =BR(LQ→ νq) = 1



Sample Composition:
- W/Z + jets
- top
- QCD fakes

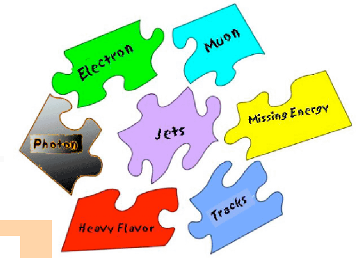
Expected =118±14

124 events seen after analysis cuts

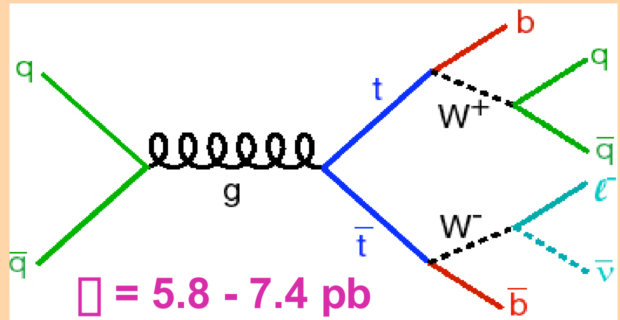


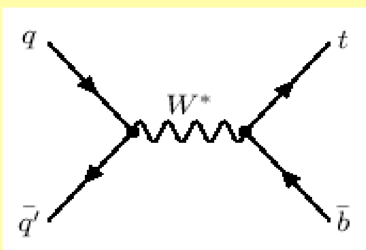
M(LQ) > 117 GeV/c^2 @ 95 % C.L.

Top Quark



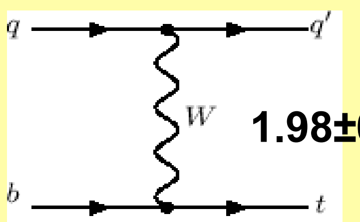
Pair production via strong interactions
- Central, spherical events
- Large transverse energy
- High P_T isolated leptons (tracks)
- Heavy-Flavored Jets



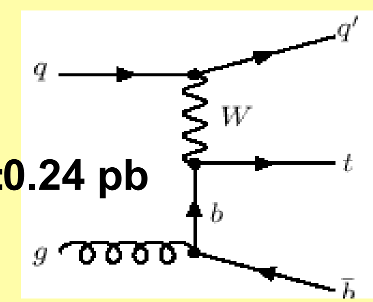


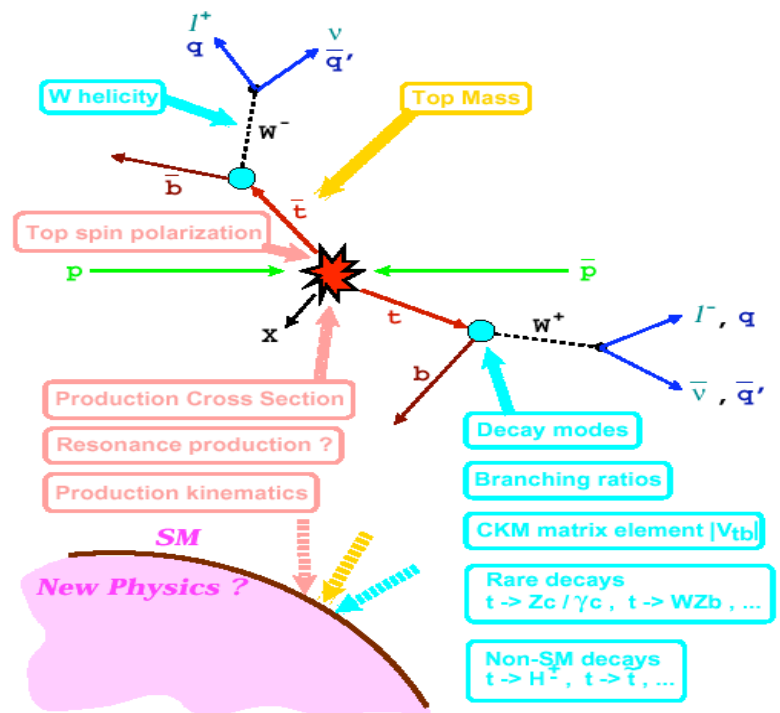
0.88±0.11 pb

EW single-top production,
x2 smaller rate, not (yet) seen



1.98±0.24 pb

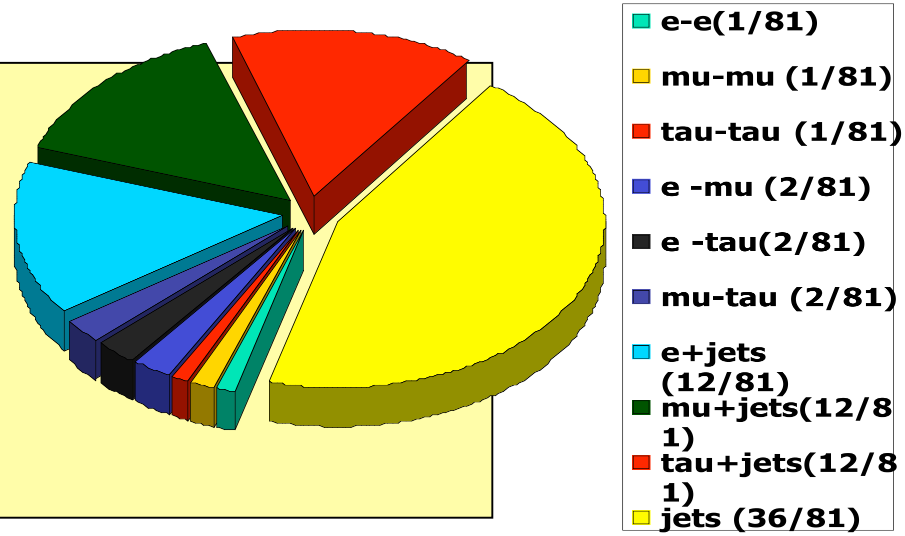


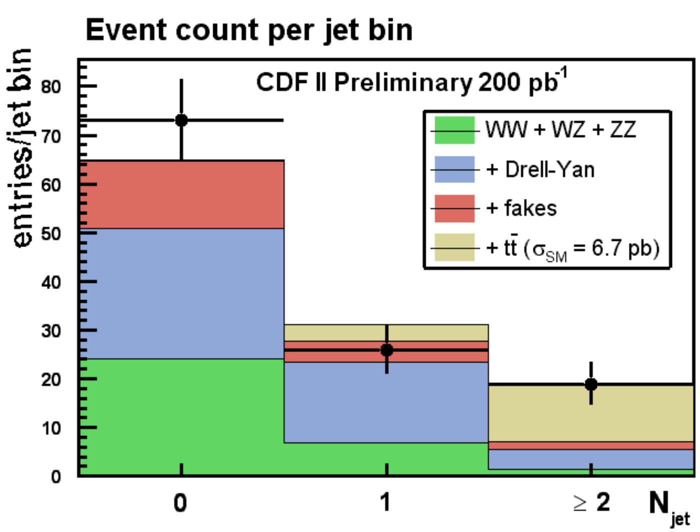


Top Data Samples

W's decay modes used
to classify the final states:
dileptons, lepton + jets, all-hadronic

B(t→ Wb) = 100%





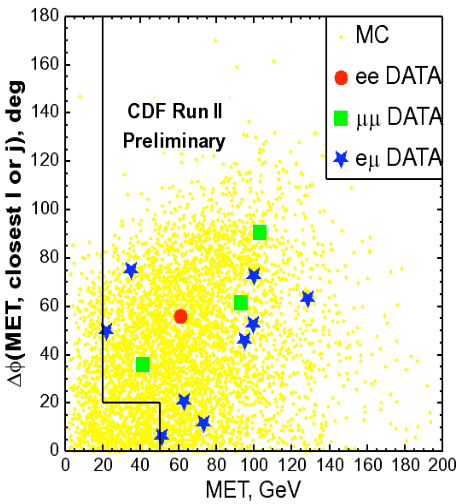
Samples are defined by counting leptons and jets

Cross section results validate
top-enriched samples

can also point toward new physics

Top Dilepton Cross Section

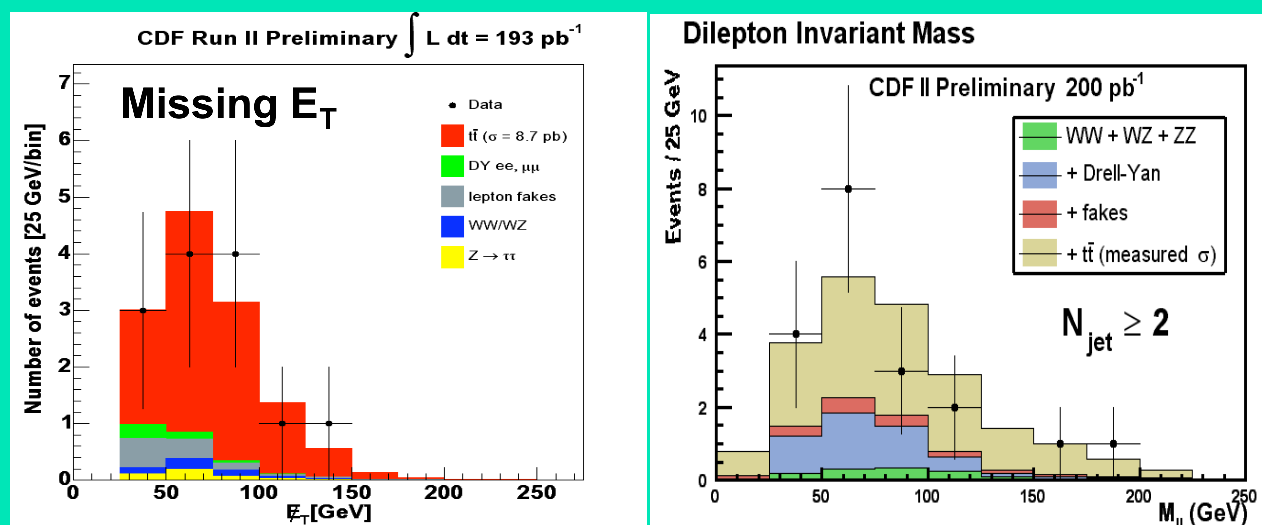
Small sample but very clean for top signal: 2 leptons, 2 jets and $\not{E}_T$



Interesting place to follow up on Run I anomalies

Tight e/μ selection complemented by e/μ + track selection

Lepton + track sample has looser ID requirements for second lepton
It is sensitive to τ lepton final state

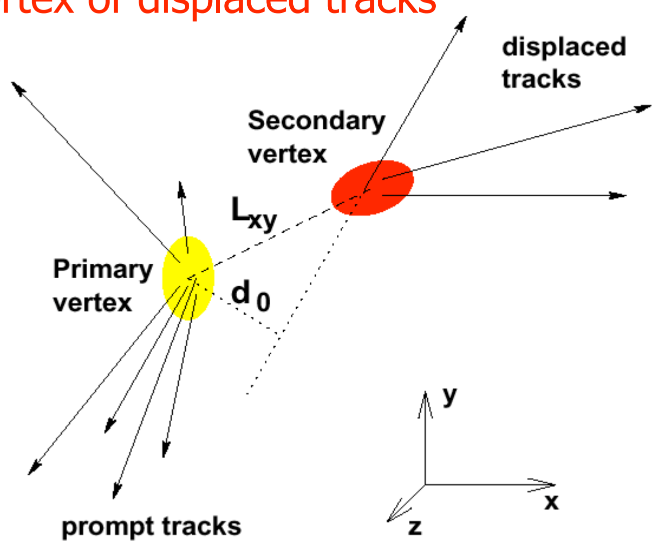


Heavy Flavor jets: tagging tools

B hadrons in top signal events

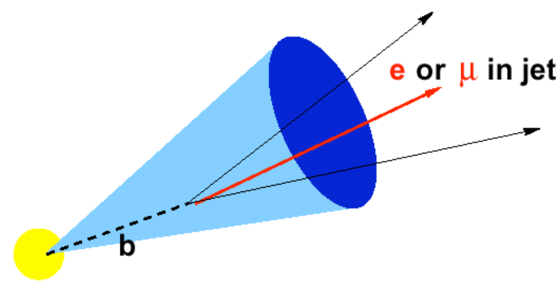
are long-lived and massive

Vertex of displaced tracks



may decay semileptonically

Identify low-pt muon from decay

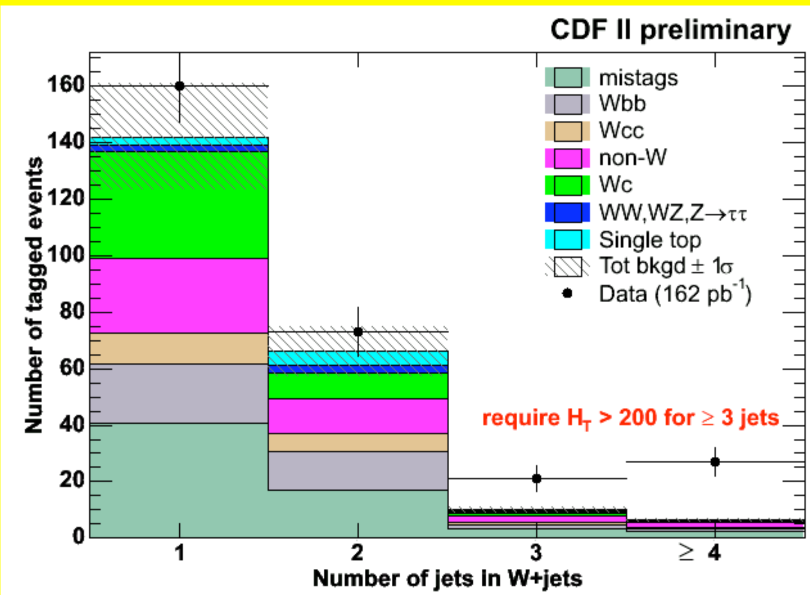


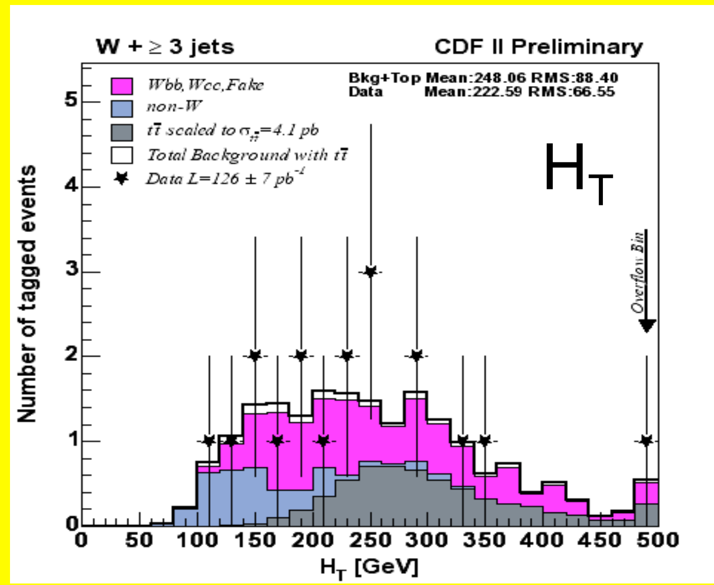
- $b \to \ell \nu c$ (BR $\sim$ 20%)
- $b \to c \to \ell \nu s$ (BR $\sim$ 20%)

55%	**Top Event Tag Efficiency**	**15%**
0.5%	**False Tag Rate (QCD jets)**	**3.6%**

Cross Section Results using Tagging

Counting experiments with vertex tag and soft muon tag in 3,4-jet bins





Backgrounds estimate in the lepton + jets sample carried on:

- using data as much as possible (non-W QCD, fake tags)
- using MC calculations for diboson and W + heavy flavor

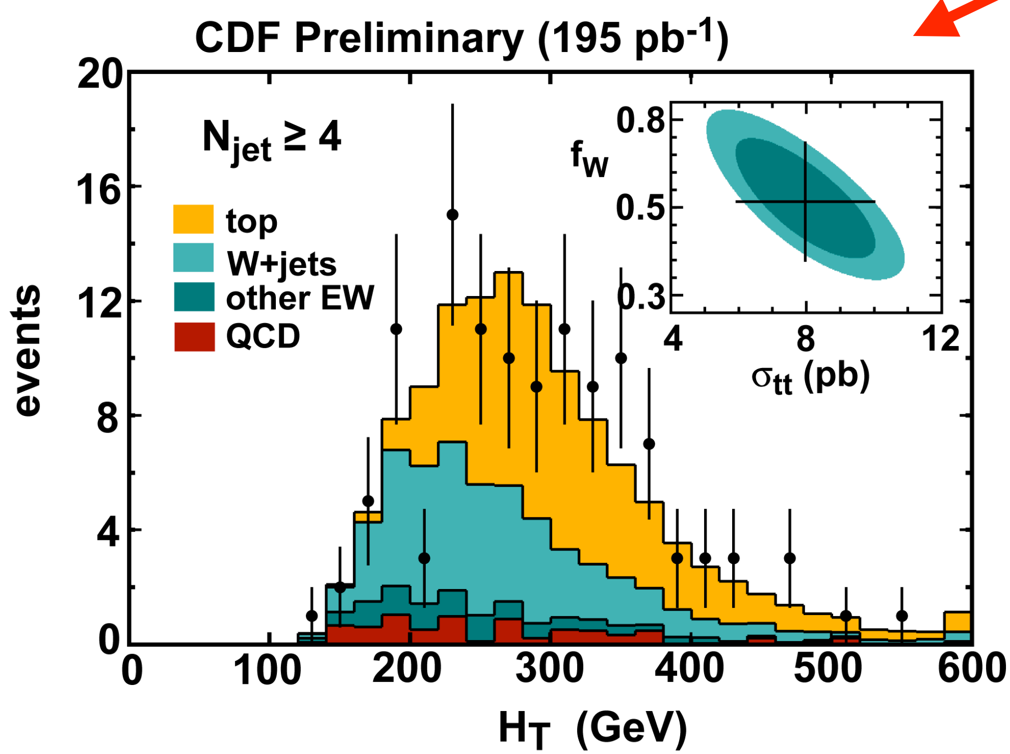
Kinematic Fits to Lepton + Jets Sample

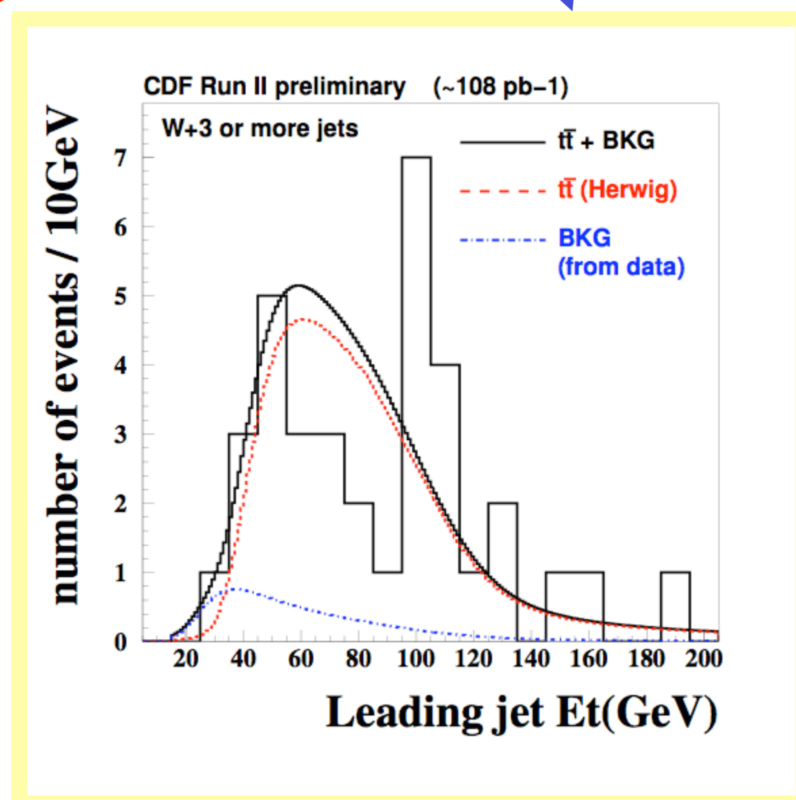
1 high p_T lepton(e,μ)

Large Missing E_T

≥3 central jets

This signature suffers from large W+jets background. Isolate signal using **kinematics** before and after tagging





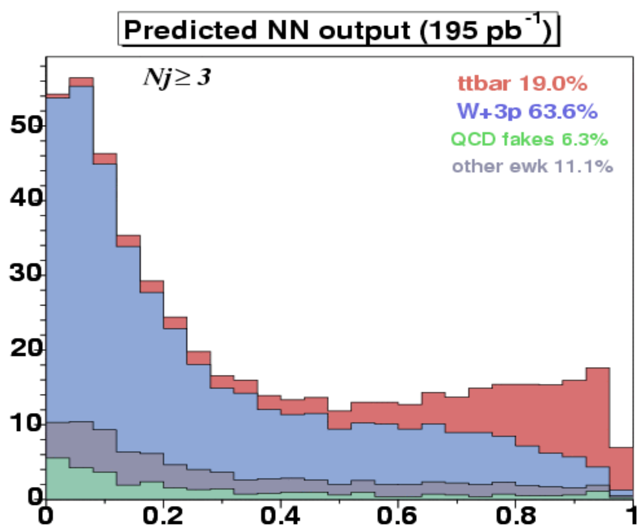
Lepton + jets: NN results

ttbar and W+jets kinematics differ modestly, but do so in several different variables.

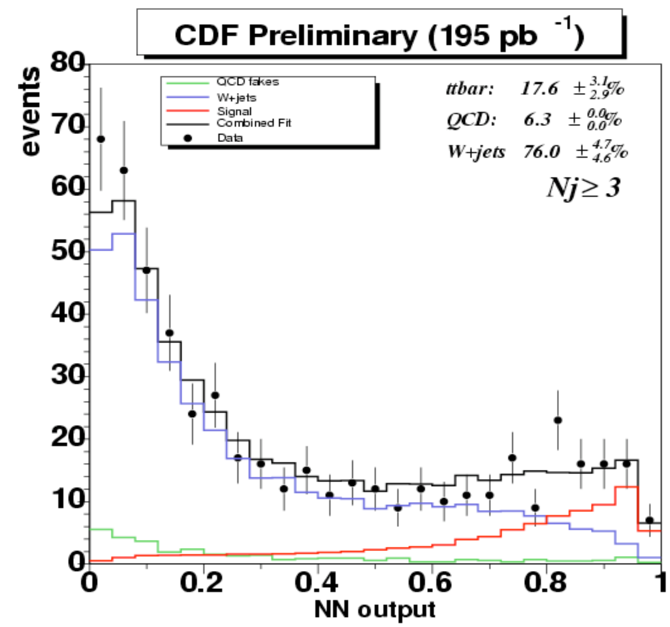
Develop a neural net to use this information optimally.

Statistical and systematic uncertainties improved compared to single-variable fit.

No b tagging information is used



Good separation between signal and background



Hadronic top

Signature: six jets, 2 tagged
Large QCD background

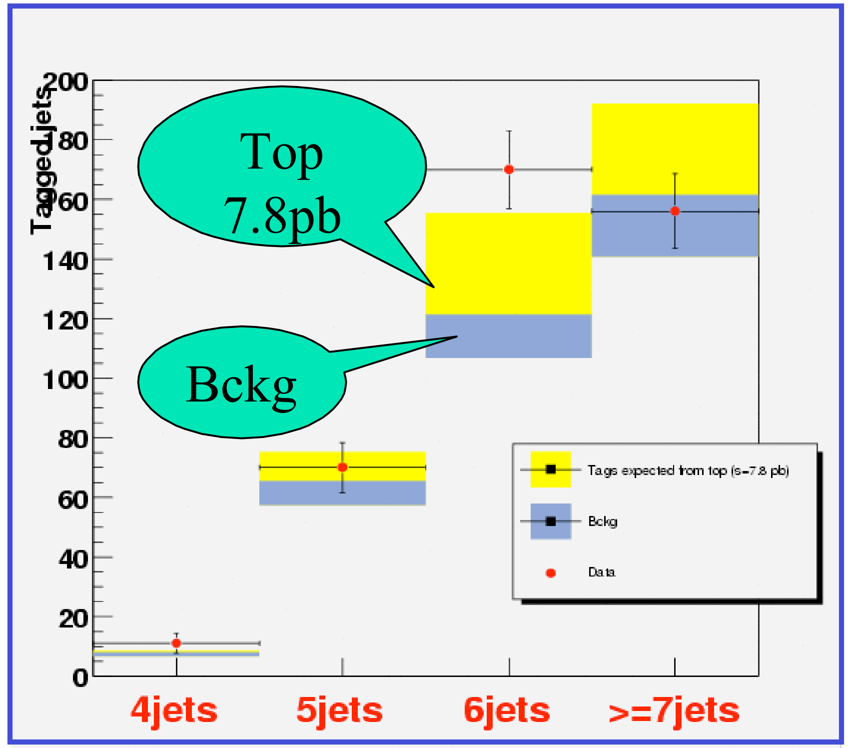
Kinematical selection of the sample complemented by b-tagging of at least one jet

Cross Section is a function of the number of observed tagged jets

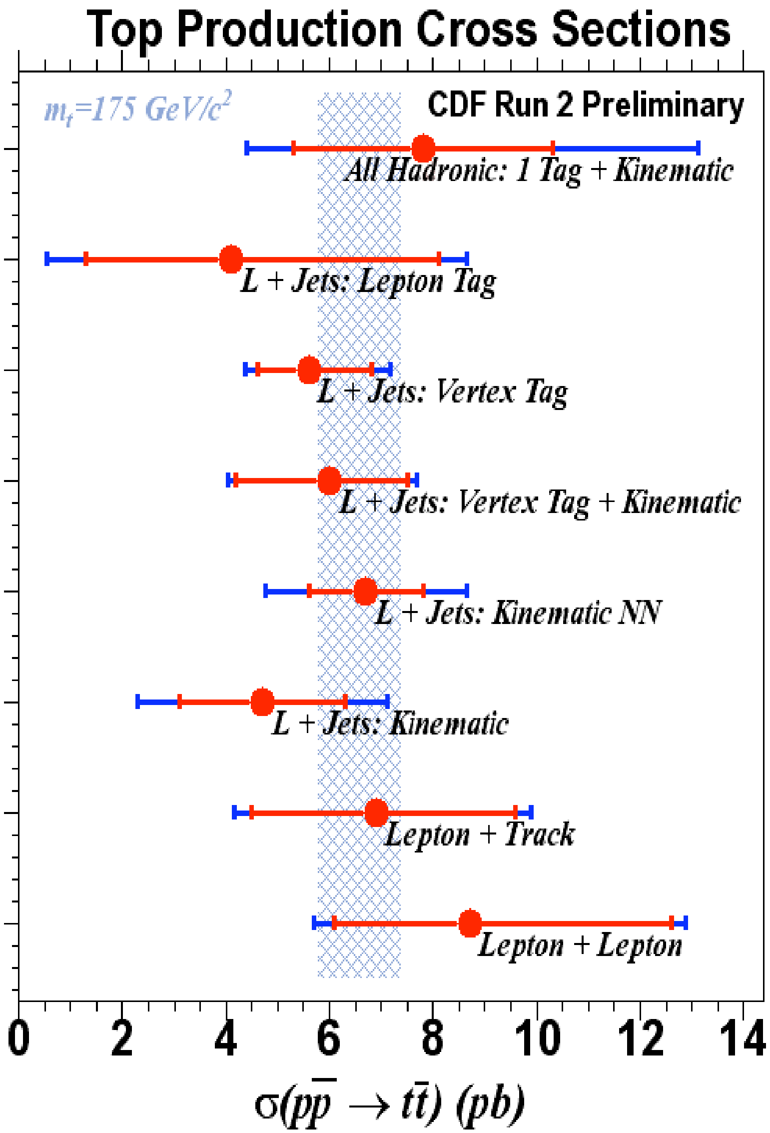
$$\sigma_{t\bar{t}} = \frac{ObservedTags - ExpectedTags}{\varepsilon_k \varepsilon_{tag}^{ave} L} \pm \delta$$

Kinematics

b-tag



CDF Top Cross Section Summary



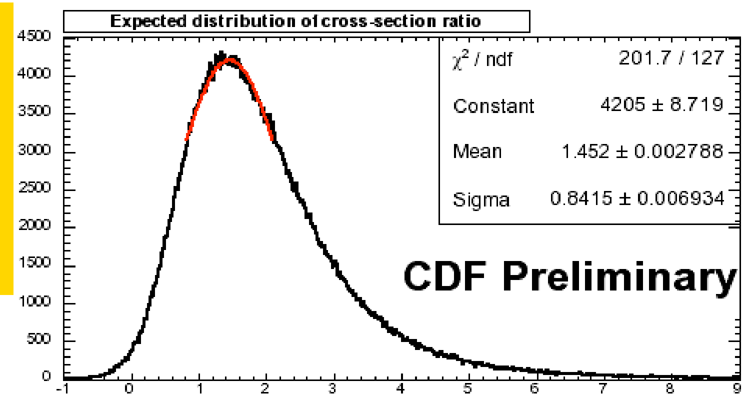
165 pb^{-1}	$7.8 \pm 2.5(\text{stat})\ ^{+4.7}_{-2.3}(\text{sys})$
126 pb^{-1}	$4.1^{+4.0}_{-2.8}(\text{stat.}) \pm 1.9\ (\text{syst.})$
162 pb^{-1}	$5.6^{+1.2}_{-1.0}(\text{stat.})\ ^{+1.0}_{-0.7}(\text{syst.})$
162 pb^{-1}	$6.0^{+1.5}_{-1.8}(\text{stat.}) \pm 0.8\ (\text{syst.})$
195 pb^{-1}	$6.7 \pm 1.1(\text{stat}) \pm 1.6(\text{sys})$
195 pb^{-1}	$4.7 \pm 1.6(\text{stat.}) \pm 1.8\ (\text{syst.})$
202 pb^{-1}	$6.9^{+2.7}_{-2.4}(\text{stat.}) \pm 1.3\ (\text{syst.})$
193 pb^{-1}	$8.7^{+3.9}_{-2.6}(\text{stat.}) \pm 1.5\ (\text{syst.})$

Cross Sections Ratio

Cross-section values assume t→ Wb always, never t→ Xb.

Ratio of measured σ's (R_σ) tests that assumption:

- Should be unity
- tests consistency with SM



Probability distribution for R

$0.46 < R_\sigma < 1.45^{+0.83}_{-0.55}$ @ 95% CL

Many systematic uncertainties cancel

Independent of theory value of theory input (PDF's, m_t)

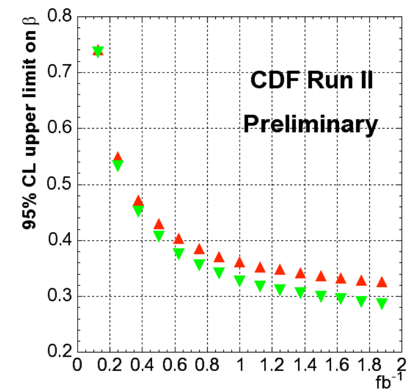
Sensitivity to non-SM decays of top, e.g. t → H^+b,

Different tan β gives different mix of *ll/lj*

Limits on non SM Br's of top (simple model)

$R_\sigma < 0.46$ @ 95% C.L.

for additional all-hadronic t→ Xb decays

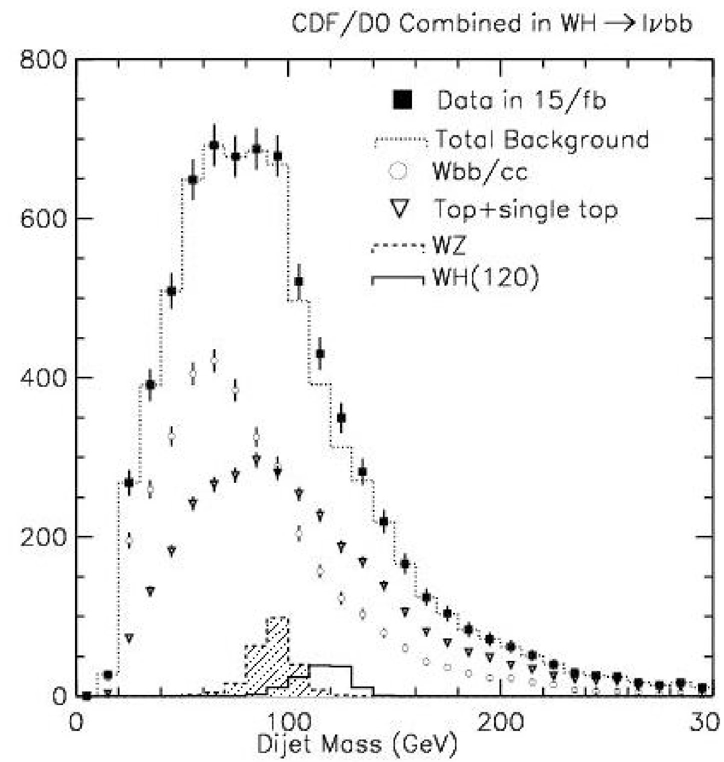


Lower jet multiplicity

The 2 jets bin is an interesting sample

- Single Top (constraining V_{tb})
- Higgs
- Exotics

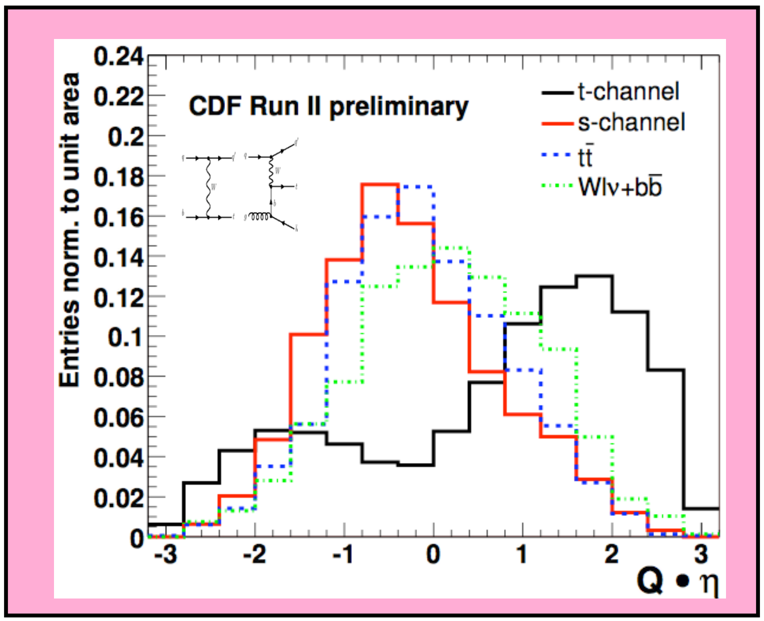
Large (QCD) background
Small cross sections

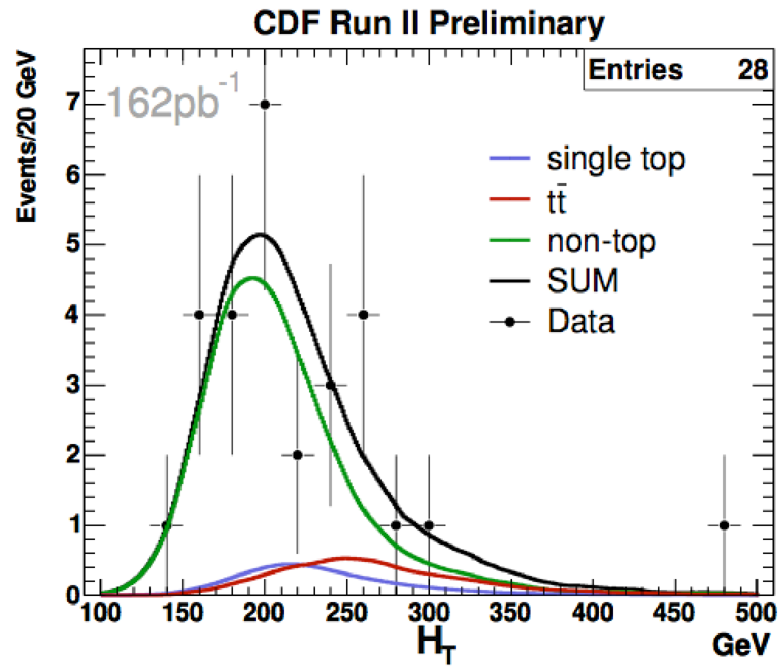


2 Jets Bin: Single Top Cross Section

Final state is W + exactly 2 jets
Tag one b jet

Search strategy employs
- Likelihood fit to H_T (combined search)
- Likelihood fit to b Q*η (t-channel only)
  - Q of lepton, η of light quark jet



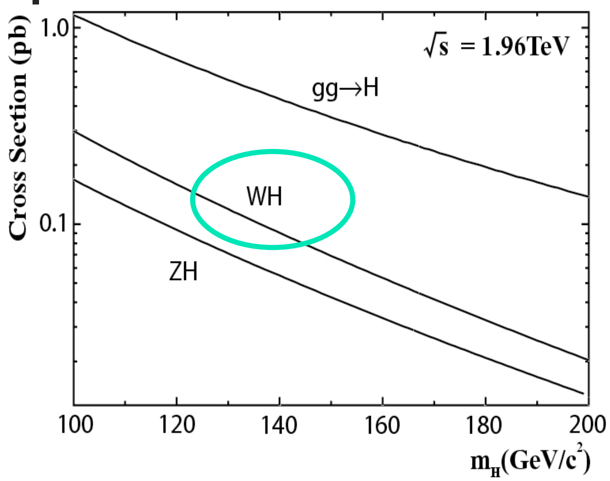


Observed as many events as expected

Cross section limits at 95% confidence level:

Combined search: σ < 13.7 pb
T-channel search: σ < 8.5 pb

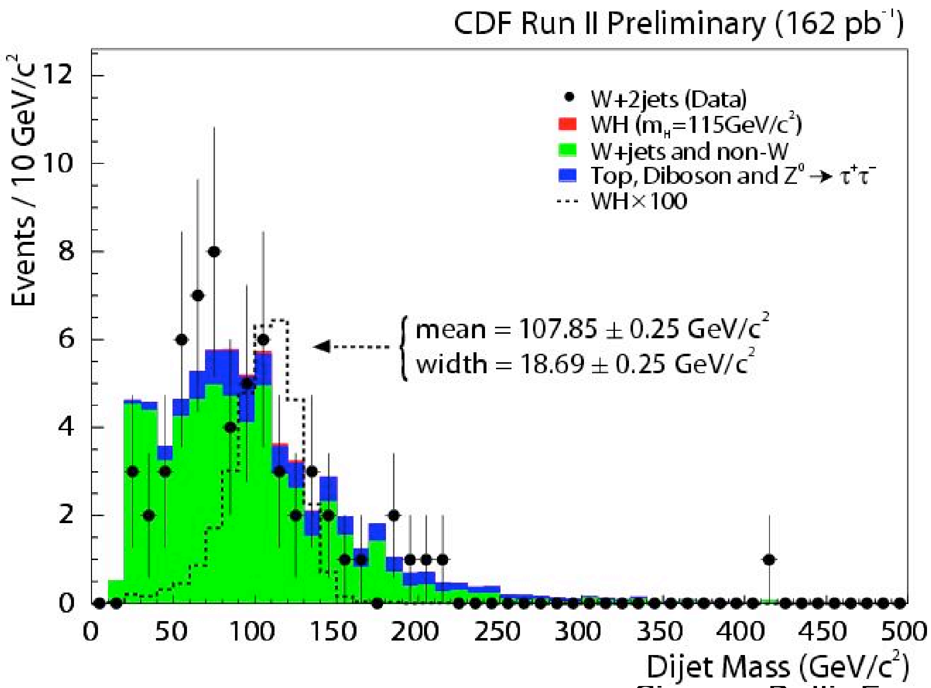
2 Jets Bin: Higgs Search



$p\bar{p} \to WH \to l\nu b\bar{b}$

Selection:

- High pt lepton data
- One high pt central *e* or μ, large MET (MET>20 GeV)
- 2 jets (at least one is tagged as b-jet)
- Veto events with >1 lepton (suppress ttbar)

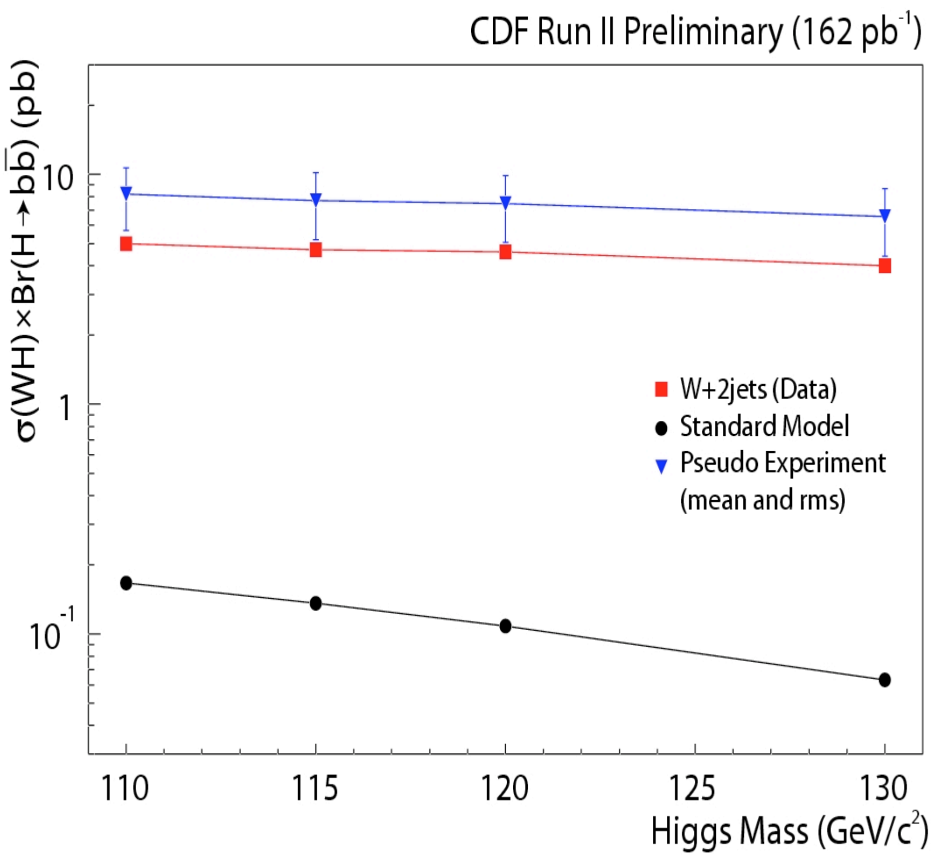


Backgrounds:

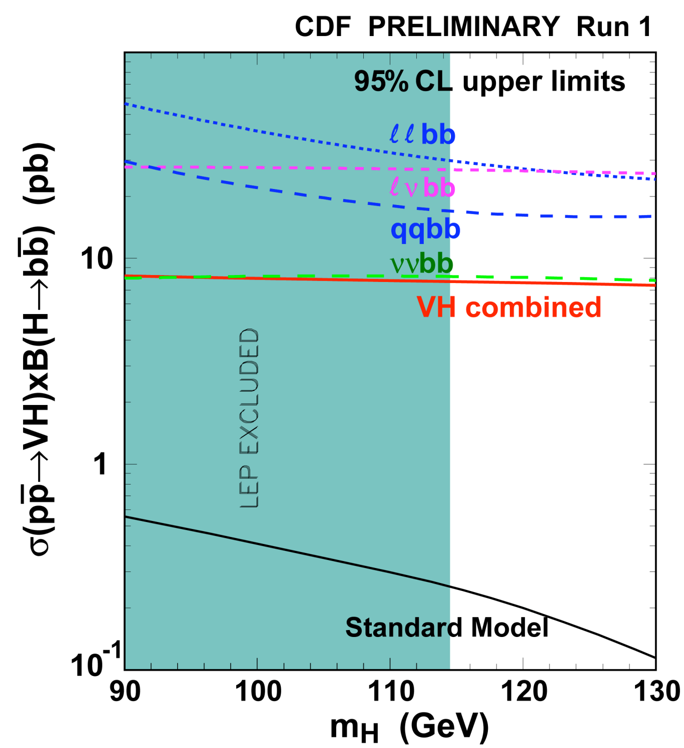
- Mistags
- Wbb, Wcc, Wc
- QCD
- tt, single t, di-boson, Z($\to$ tt)

S/ B = 0.054

Higgs Search (cont'd)



Future improvements :
Include forward electron
Improvement jet energy resolution
Improve b-tagging
Combine with other channels

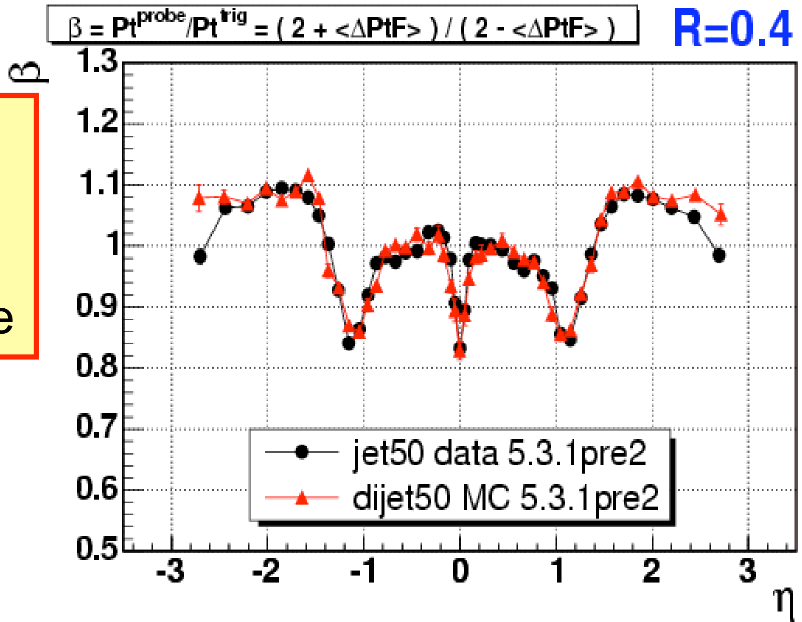


Improved limit over Run1, but sensitivity of current search is limited by statistics

Top Mass Measurement Challenges

Many combinations of leptons and jets: which one is correct?

- Choose assignment kinematically most consistent with top
- Use all combinations, but weight them



Link observables to parton-level energies

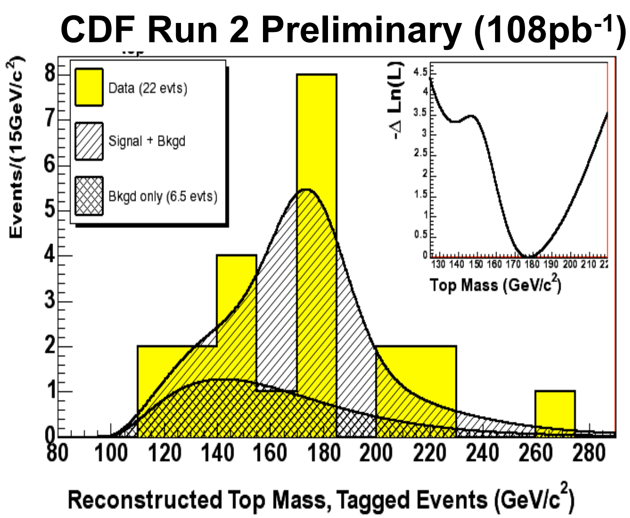
- Accurate detector simulation vital to precision physics measurements
- Large systematic uncertainty from energy scale

Traditionally, likelihood fit methods have been applied: data is fitted to most likely mass template from Top MC

Currently we are exploring the possibility of adding event kinematic information, possibly including matrix element information

Top Mass Results: template fits

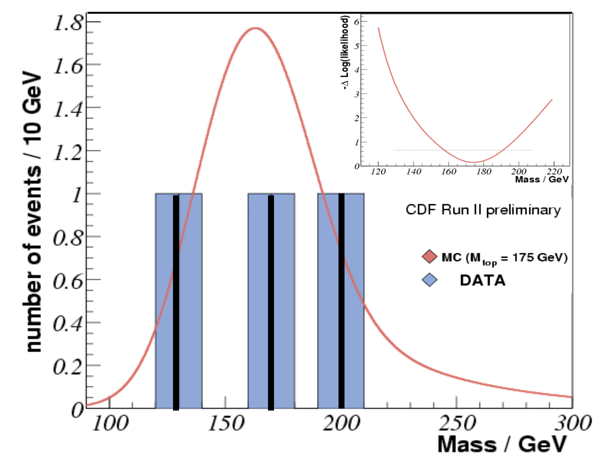
22 vertex-tagged events from lepton+4 jet sample



Reconstruct m_t via kinematic fit
Choose single combination with best χ^2 from over-constrained fit
Compare to templates from
- Top signal MC
- Backgrounds (fixed relative)

6 dilepton candidates in 125.8 pb^{-1}

Underconstrained kinematic fit
For each lepton-b pair assignment
Calculate best raw mass, from most probable combination
Fit to signal and background templates



M_{top} = 175 ± 17(stat.) ± 8(syst.) GeV/c^2

$M_{top} = 177.5\ ^{+12.7}_{-9.4}$ (stat.) ±7.1 (syst.) GeV/c^2

New Run I mass combination

Old DØ top mass average: 172.1 ± 5.2(stat.) ± 4.9(sys.) GeV

New DØ top mass average: 179.0 ± 3.5(stat.) ± 3.8(sys.) GeV

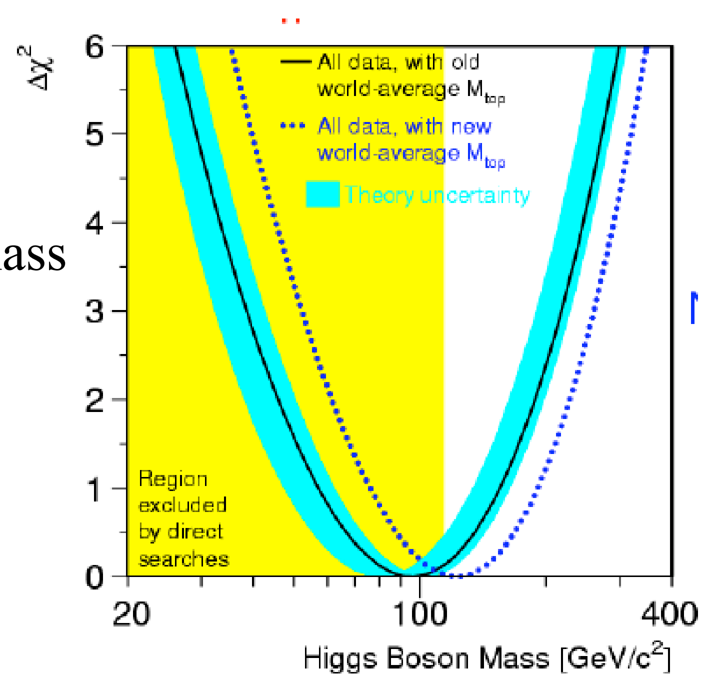
Combination Method:
weighted mean of un-correlated measurements
numerical minimization of χ^2 for correlated measurements

$\chi^2_{\text{min}} = 2.6$ for 4 degrees of freedom: 63.2% probability.

Experiment	Measurement	Pull#	Weight [%]
CDF	leptons+jets	−0.32	22.2
	di-leptons	−1.01	7.1
	all-hadronic	+0.75	6.9
DØ	leptons+jets	+0.66	57.8
	di-leptons	−0.80	6.0

#Pull: $(x_i - \overline{x})/\sqrt{\sigma_i^2 - \sigma^2}$

New Higgs mass constraint



$$M_{top} = 178.0 \pm 4.3 \text{ GeV}$$

$$\log M_H = 2.07^{+0.20}_{-0.21}$$

$$M_H = 117^{+67}_{-45} \text{ GeV}$$

$$\text{or} < 251 \text{ GeV (95\% CL)}$$

Dynamical Likelihood Method

<u>*For i-th event*</u>

M;Prod,decay,propagator

$$L^i(M_{top}) = \int \underset{combnsol}{\sum\sum} \frac{2\pi^4}{Flux} |M|^2 F(z_1, z_2) f(p_t) w(\mathbf{x}, \mathbf{y}_i; \alpha) d\mathbf{x}$$

M : Matrix element of tt process, F : Parton distribution function (Z_1,Z_2)

$f(p_t)$: Probability for the Pt of tt system.

w : Transfer function, x ; partons $\Longleftrightarrow$ y ; observables

dΦ : phase space volume ; assume that each final state parton occupies a unit phase volume(they are already observed!)

Three Summation/integration :

ν_z solution(2) , possible combination and parton momentum generation from jets by MonteCarlo(Random) along the transfer function

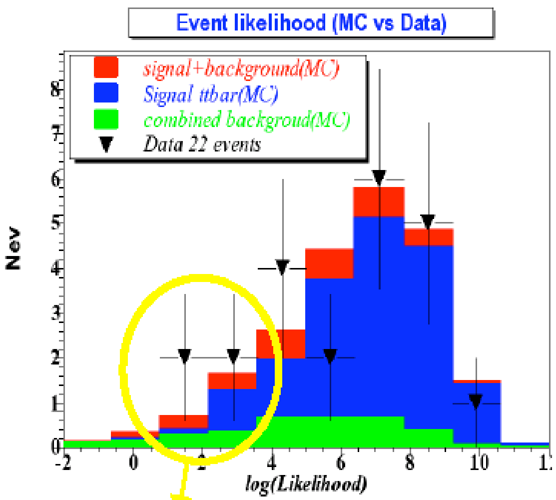
To obtain M_{top}, $\prod_{event} L^i(M_{top}) \longrightarrow$ $\mathbf{M_{top} = \overline{M}_{max}}$

<u>*(Maximum likelihood)*</u>

Results

22 tagged l+4 jets events

Event Likelihood distribution: $L^i_{ev} = \int L^i(M)dM$

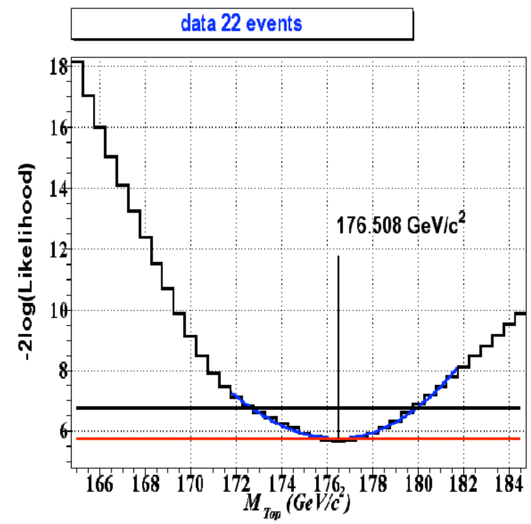


More likely background!?

Combined background includes each sources with expected number of events.

Agreement is quite good!
Data is well understood by MC

Minimization



Further corrections to the transfer function (expected bckg, template mass) are applied

More information
Less statistical uncertainty

$M_{Top} = 177\,^{+4.5}_{-5.0}\,(stat) \pm 6.2\,(sys)$

Conclusions

Many exciting results are currently produced at CDF
first high P_T physics papers will be submitted very soon!

Many of our results interplay nicely :
From testing the SM processes to searches for Exotica
same signature, different physics

The Puzzle is becoming more and
more interesting!

Backup Slides

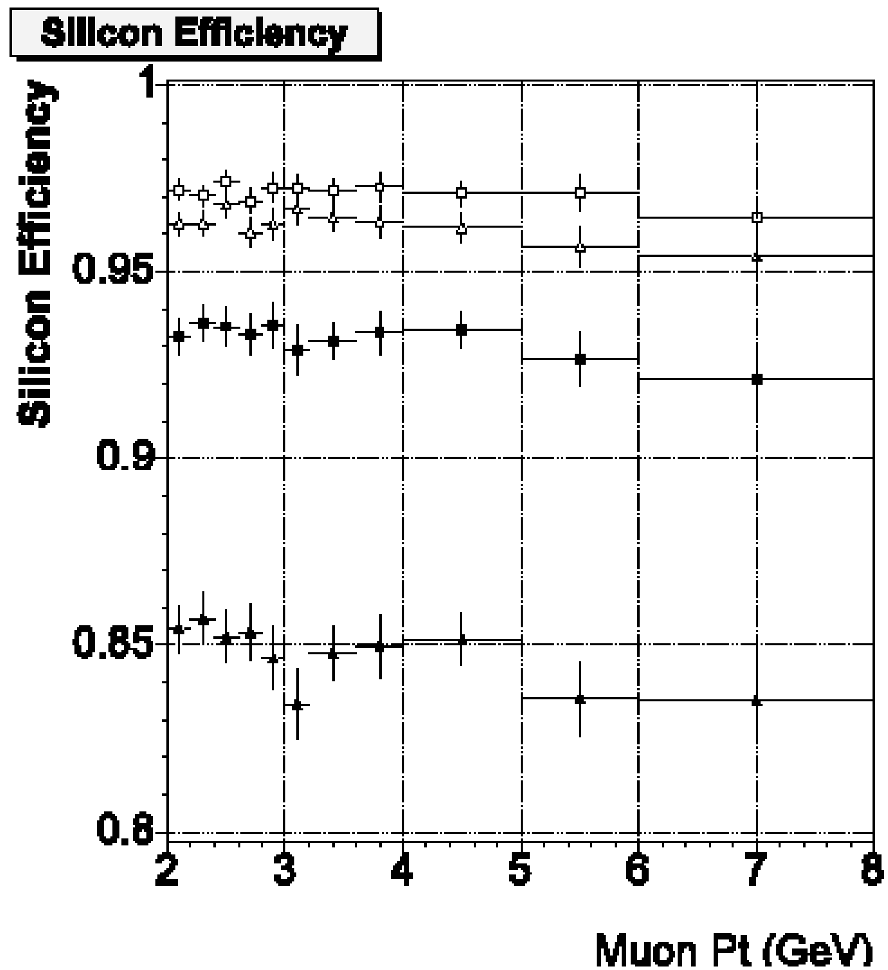
COT aging issues

What does "COT Aging" mean?

- Drift chamber aging
  - Decline in operating performance with time
  - More specifically, loss of gain under irradiation
  - Usually caused by deposits on wire surfaces
- How do we detect aging
  - Loss of gain means less charge – shorter pulse widths
  - Decrease of COT hit widths, COT/XFT efficiency
  - Small chambers directly monitor gas going to chamber
- Details:
  - http://www-cdf.fnal.gov/upgrades/cot/aging_committee.html

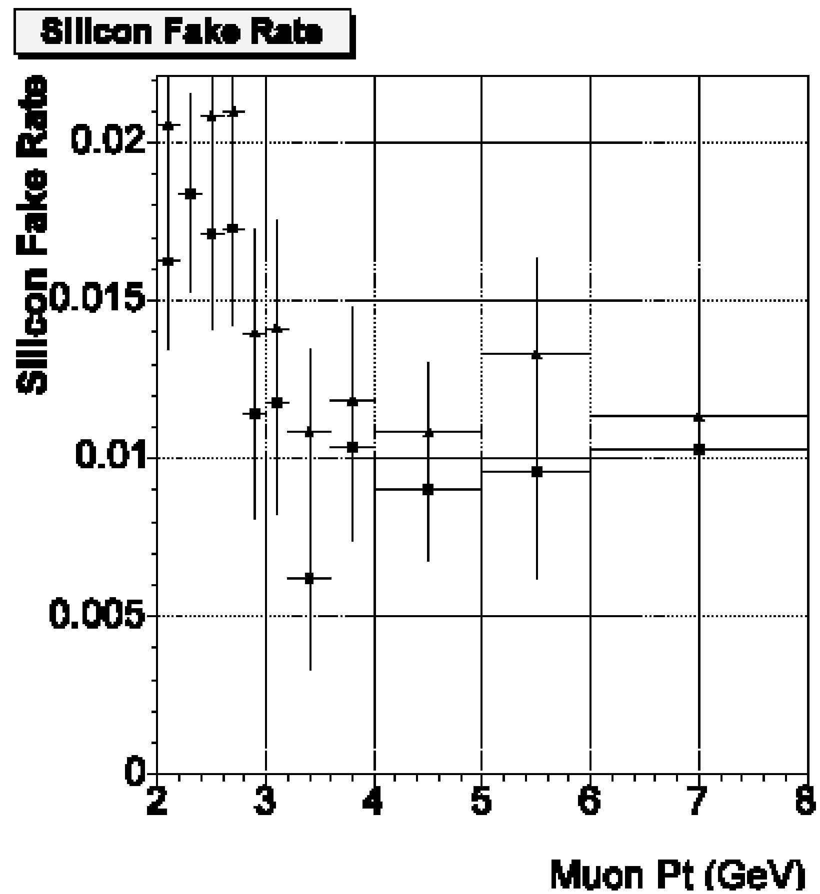
Silicon tracking efficiency

- Sample of muons from J/psi's
- Track is in fiducial volume
    - 3 SVXII layers needed
- Top two curves are axial and stereo acceptance (ladders alive)
- Bottom two curves are efficiency
- 3-hits define a track (5 layers total)
- 3-D uses available stereo(2) & Z(3) strips
- Ratios provide rating for pattern recognition



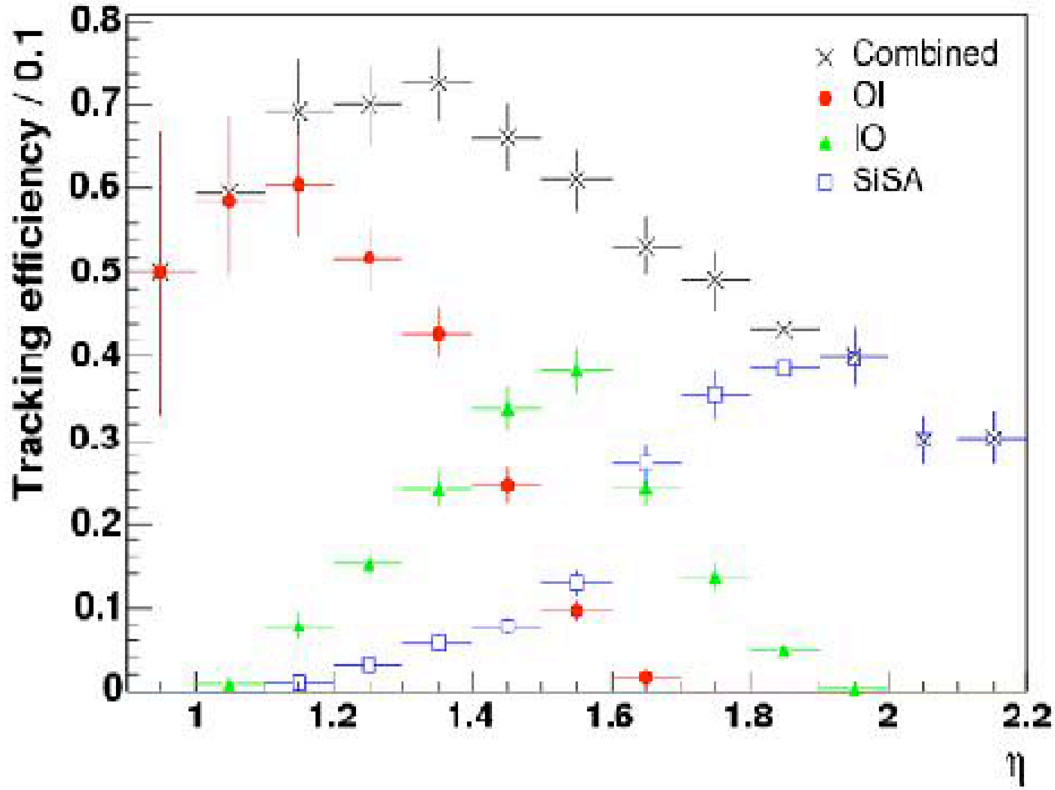
Rate of mis-measured tracks

- Negative impact parameters define possibly mis-measured tracks
- Fakes beyond 3 sigma plotted
- Triangles have stereo information
- Much better than Run 1

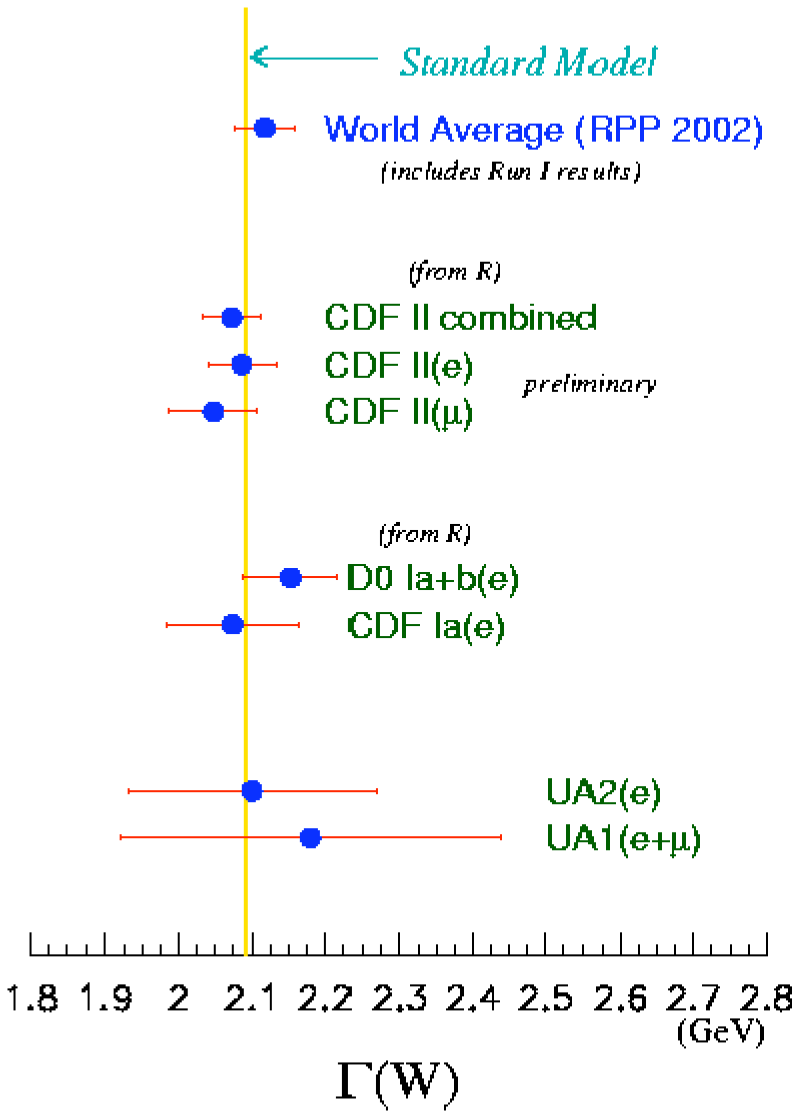


Forward Tracking efficiency

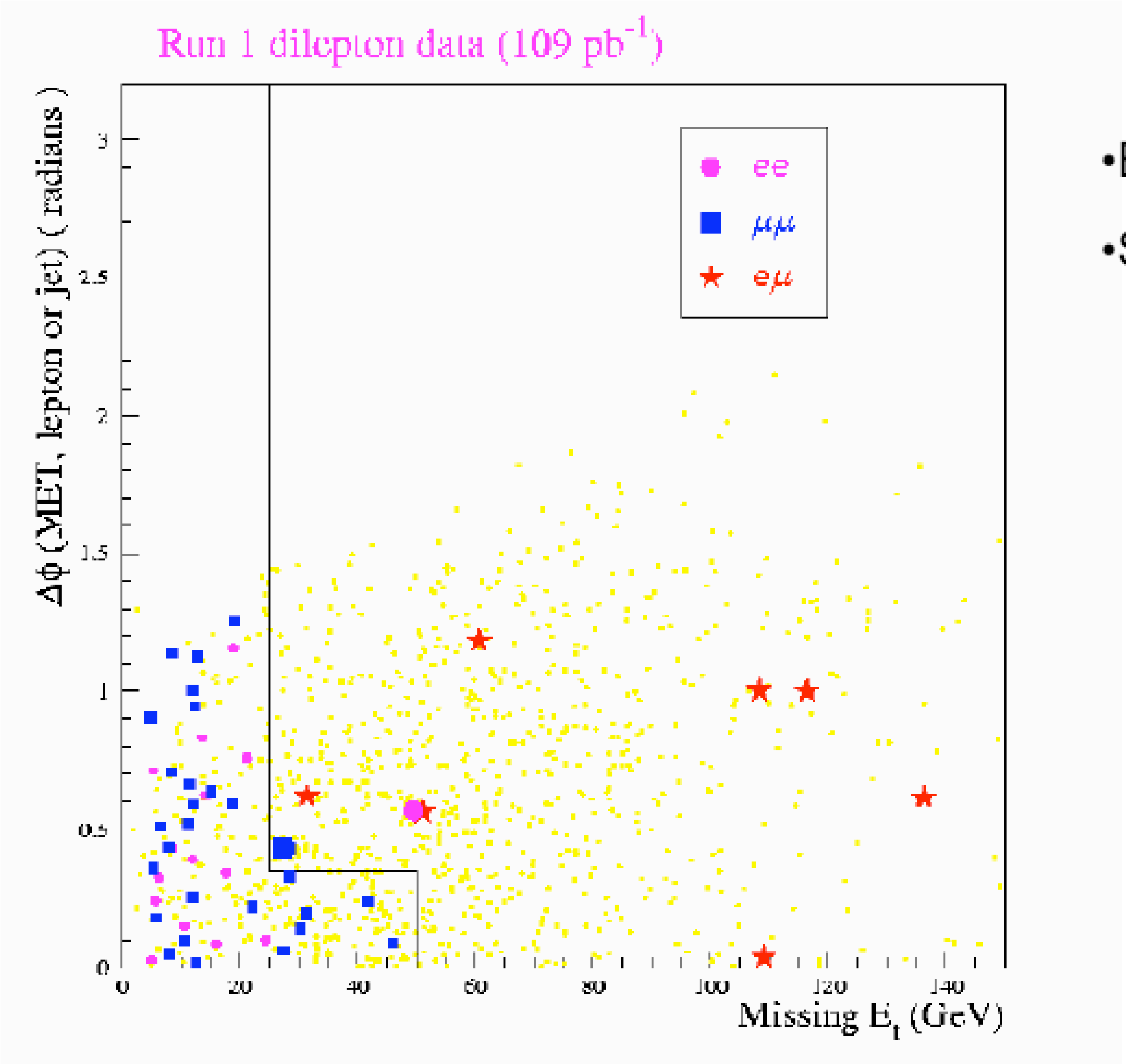
- Z→ee central+plug
- plug energy is denominator
- ISL+SVXII only
- Two 3-D hits & vertex seed silicon track (SISA)
- OI seeded by COT hits
- IO attaches COT hits to SISA



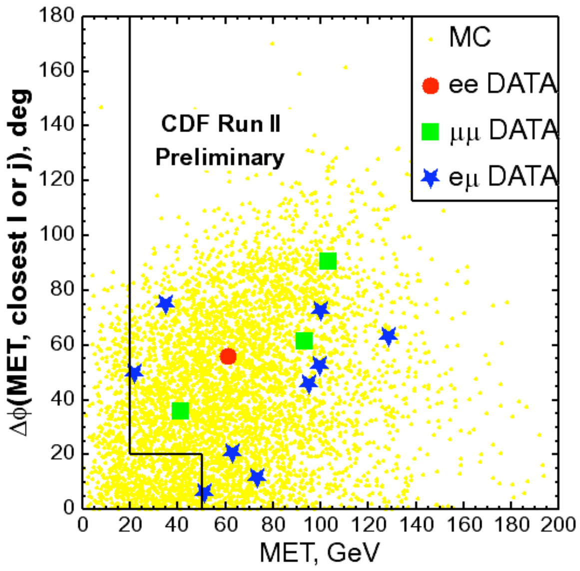
Γ(W)


Standard Model
World Average (RPP 2002)
(includes Run I results)
(from R)
CDF II combined
CDF II(e)
CDF II(μ)
preliminary
(from R)
D0 Ia+b(e)
CDF Ia(e)
UA2(e)
UA1(e+μ)
1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8
(GeV)
Γ(W)

Run 1 Dileptons



- Events at large missing ET
- Study run2 sample



Old Higgs mass limit from M_{Top}

Old:

$$
\begin{aligned}
M_{top} &= 174.3 \pm 5.1 \text{ GeV} \\
\log M_H &= 1.98^{+0.21}_{-0.22} \\
M_H &= 96^{+60}_{-38} \text{ GeV} \\
\text{or} &< 219 \text{ GeV (95\% CL)}
\end{aligned}
$$

Z' limits

channel	L (pb^{-1})	Z_I 95%C.L (GeV)	$Z_□$ 95%C.L (GeV)	$Z_□$ 95%C.L (GeV)	$Z_□$ 95%C.L (GeV)
ee	200	570	610	625	650
□□	126	425	455	465	495